Five Years' Medical Work on Lake Nyasa

By Robert Howard, M.B., B.Ch. (Oxon.)

Price Half-a-Crown net

A REPORT TO THE MEDICAL BOARD

OF THE UNIVERSITIES' MISSION

ON THE

HEALTH OF THE EUROPEAN MISSIONARIES

IN THE

LIKOMA DIOCESE.

INCLUDING

AN HISTORICAL SURVEY FROM THE COMMENCEMENT OF WORK IN NYASALAND

By

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PREFACE

This Report was, in the first instance, made by Dr. Howard to the Medical Board, and by them communicated to the General Committee of the Universities' Mission to Central Africa.

The Committee, recognizing the very great value of the report, and, in view of the large amount of interesting matter contained in it, have authorized its publication.

It may be added that the questions addressed to the Medical Board at the conclusion of the Report were carefully considered and a detailed answer forwarded to Dr. Howard in July last.

November 1904.

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INTRODUCTION

The object of this Report is to place before the Medical Board the facts concerning the past and present health of the members of the Mission, together with suggestions as to the means whereby their health may be further safeguarded and improved in the future.

In dealing with this question, the historical method has been largely employed. It was thought that this method would render more intelligible some of the conclusions and recommendations herein contained, and, further, that it would supply a medical summary which might be of use for purposes of reference. The statistics here collected are not readily accessible, and they have not before been collected or tabulated. This being the case, it was thought advisable to make them as complete as possible even at the risk of being tedious. The historical and statistical parts of the Report can easily be omitted if desired, and attention can be directed to the general discussions and suggestions; whereas their exclusion from the Report might have seriously impaired its usefulness for reference purposes. Moreover as the various stations of the Mission differ much as regards both their health records and also the improvements recommended, it has been thought best to deal with each one separately in the first instance, and afterwards to give a general review of the whole.

Malaria is the scourge of the whole of Central Africa, so that for European residents the health problem becomes mainly a question of the avoidance of malaria. In view of the recent discoveries of the relation of the mosquito to the propagation of malaria, the destruction of mosquitoes or the prevention of their bites becomes a matter of primary importance. Hence a considerable amount of this report will be devoted to observations on mosquitoes at the various stations, to the conclusions to which such observations lead, and to the precautions which they suggest.

Plan of Report.—In accordance with the above principles the following plan has been adopted. Each European station is taken in turn and discussed under the following heads. First, the general physical characteristics of the locality, for these have an important bearing on the general question of health, and more particularly on the subject of mosquitoes. Secondly, the history of the Mission Station is given, and then the health record of the workers who have been stationed there. Next, observations on the prevalence and distribution of mosquitoes in the neighbourhood are enumerated, with a view to ascertaining how far these observations accord with the facts of the health record. Finally, from a consideration of both the health record and the mosquito observations, rules and recommendations for the future are deduced.

After this detailed consideration of the Stations, a general review of the health of the whole body of European missionaries, together with statistics of deaths, invalidings, and cases of blackwater fever will be given, and the causes of the very marked improvement in health which has taken place during recent years will be discussed. Then will follow a summary of the methods which have been recommended by various authorities on the subject for dealing with mosquitoes in their relation to malaria, and a consideration of which methods are most beneficial here, in Central Africa, on Lake Nyasa, and how far they can reasonably be applied to a Missionary body, and also what precautions they suggest when new stations are founded in the future.

Finally, some special points which lie rather outside the main scope of the report will be dealt with. Notes will be added on certain questions (e.g. the working of 'the two years' rule,'* and the question of return after blackwater fever) which frequently come before the Medical Board. And the advice of the Medical Board will be asked on certain points connected with the administration of quinine, and other matters.

* The paper of conditions issued to those who desire to join the Mission, contains the following clause: "The Bishops offer a passage home at the end of the first two years of completed service."

NOTE

On Certain Precautions against Mosquitoes, of general application.

In order to avoid repetition it will be well to enumerate certain rules which are equally applicable all over the diocese, and which should be rigidly adhered to. For the most part these are already enjoined in the "Hints on Health,"* but they are somewhat amplified here (No. 2 is altered and No. 5 is new).

1. Mosquito nets should invariably be used. They should be made according to the "Nyasa pattern" at the Office, i.e. seven feet long, three feet wide, *with calico round the lower two feet of the net.* This latter point is of great importance as it prevents mosquitoes from biting the hands or feet if they should rest during sleep against the side of the net (see Malarial Commission Reports). Many nets are made ridiculously small, e.g. six feet by two feet, and no with calico round the bottom.

Mosquito nets are in general use throughout the diocese (except on the steamers). It must be confessed, however, that sometimes they are of no practical value, because they are out of repair. *A net full of holes is worse than useless, for it gives a false idea of security.* With hard usage (travelling about, etc.) a net will only last a year. When it begins to get rotten and tear into small holes, it is wasted labour to try to mend it, as there are always a number of holes which pass unnoticed, but which admit mosquitoes. It should, therefore, be destroyed, and a new one made.

I have endeavoured to meet this difficulty by ordering out spare mosquito netting, and distributing it to each station. Also the care of the mosquito nets throughout each station has been made the special business of the nurse. These measures will do something; but what is really wanted is an *intelligent appreciation* of the object and need of a mosquito net by all members of the Mission, and a recognition of the fact that anopheles may be present and may bite unnoticed at night when, as is often said, "there are practically no mosquitoes here."

Another point of importance is that the *bed* should be sufficiently large, not less than seven feet by three feet at the least. A big bed gives room to move about without coming in contact with the sides of the net, whereas a small bed with the net tucked in round it takes away all the advantage of a big net.

* "Hints on Health," by Robert Howard, M.B. Published by the Universities' Mission. A copy of this is given to each person on joining the Mission.

2. When possible, avoid waiting about after sunset in the neighbourhood of the lake shore, and of native huts.

This is a modification of rule (b) in the "Hints on Health." "As far as possible avoid going out after sunset. Never sit out in the evening except under a mosquito net." This rule may be a counsel of perfection; but it is hardly practicable in a Mission Station, especially with a community of people each having their own house, but a common dining-room; also, in the stations occupying healthy sites, it is not necessary.

On the other hand it should be recognized that the neighbourhood of the lake shore is the great breeding ground of anopheles at most stations of our Mission; and also that anopheles, and very possibly infected ones, are present in almost every native. In other words, "*It must be realized that malaria is an infectious disease, and that it is present in practically every native hut*" (Malarial Commission Reports, Stephens and Christopher).

Of course, as when a steamer comes in, it may be necessary to go down to the Lake at night, and it may be necessary for the clergy or nurses to go into the native villages. These are risks incidental to the work of a missionary and cannot be avoided; but the danger of being bitten by mosquitoes when walking is much less than when waiting about. The rule is aimed against going *unnecessarily* to the lake shore (as is very pleasant on a moonlight night) or to villages.

3. The ankles can be effectually protected against mosquito bites by wearing two pairs of socks or a pair of gaiters, after sunset.

4. Fumigation by means of pyrethrum powder thrown on burning charcoal undoubtedly keeps away mosquitoes for an hour or two. A little pyrethrum burnt under the dinner table just before dinner time is very effectual. Oil of lavender rubbed on the skin of the face or hands or ankles is also a fairly efficient preventive, and is quite pleasant to use.

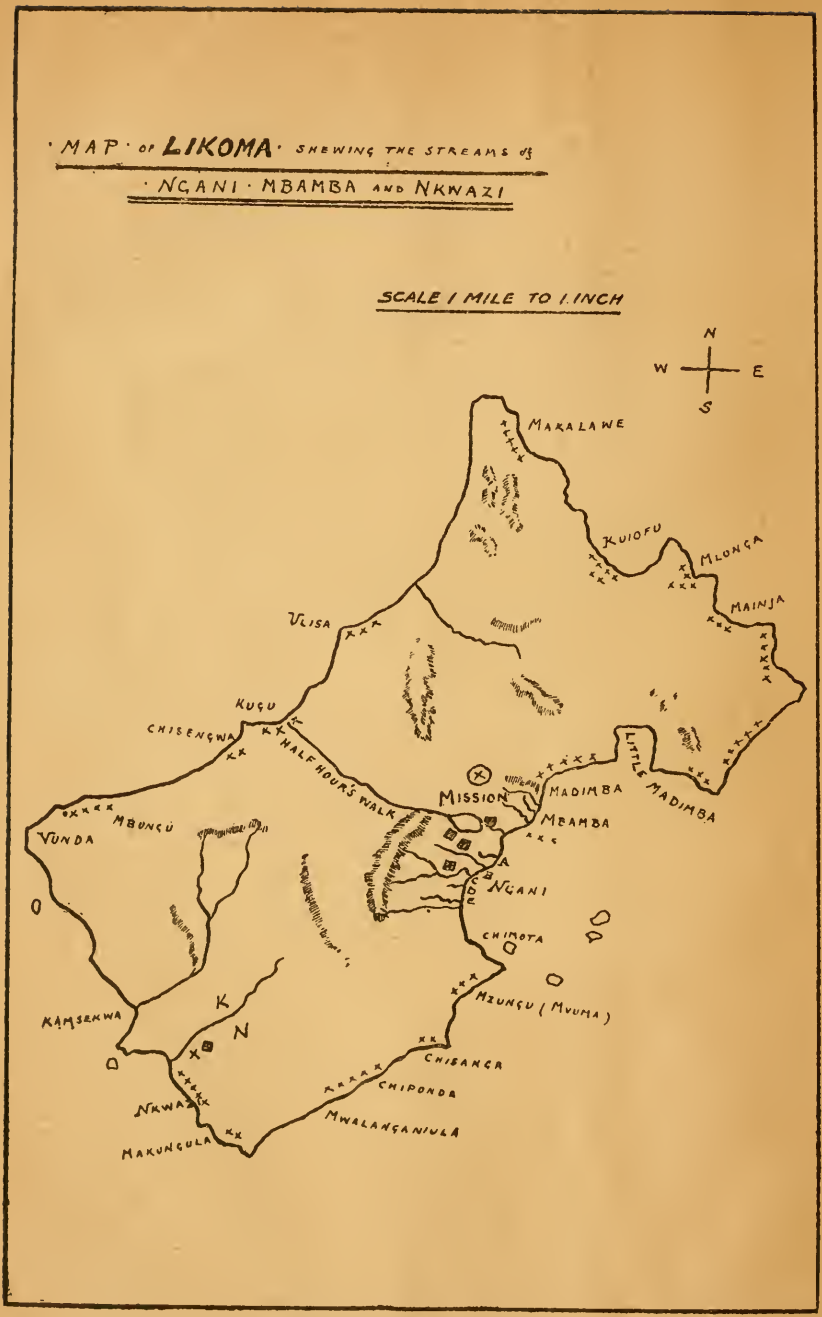
These precautions should be adopted in places where mosquitoes are troublesome during the evenings; they are hardly likely to be employed elsewhere.

5. Destruction of Culex larvæ.—On every Mission Station, before the wet season begins, all old tins, pots, etc., should be collected and buried in a pit. During the wet season the grass round kitchens, sculleries, etc., should be kept hoed, so as to remove cover where pots and tins can be hid, and all fresh tins, etc., should be thrown away into a pit made for the purpose. The observance of this rule would add greatly to the comfort of many members of the Mission. For the most part culices breed in artificial collections of water (such as occur in old pots, tins, etc., during the wet season) close to houses. If they are troublesome in any room a hunt will generally reveal breeding-places close by. The smallest tins will often suffice to breed large numbers.

It is necessary to educate both Europeans and natives to realize that culices are mainly bred in this way, and that therefore they are largely preventable. The natives, at any rate, have no idea of the origin of mosquitoes. A few bottles of mosquito larvæ kept till they hatch out will be sufficient to convince people, and then intelligent co-operation can be obtained.

Where vessels have to be kept containing water (e.g. to prevent ants reaching the legs of meat safes, etc.), paraffin should be applied once a week.

N.B.—It is best to collect all old tins, etc., *before* the wet season, as this can easily be done. As soon as the rains begin they get hidden in the young grass that grows up, and are hard to find. During the seven months or so without rain they, of course, contain no water and so do no harm.



MAP OF LIKOMA ISLAND.

PART I.

Medical Reports of Stations.

LIKOMA.

Physical Characteristics.—Likoma is an island four and a half miles long, by two and a half miles wide, lying near the east shore of Lake Nyasa in a large bay, the southern extremity of which (Mala Point) affords protection from the south to the eastern half of the island. The western half of the island (and the station at Nkwazi) is exposed to the full force of the stormy south wind.

The shortest distance between Likoma and the mainland is about four miles. From the harbour to the College is about six and a half miles.

The harbour (Mbamba) is one of the best on the lake ; it is well protected, has extensive anchorage, and is easy to make at night or in heavy weather. The island is a mass of granite rock, with overlaying sandy soils, through which protrude granite boulders. No pure clay exists except in small patches in the beds of streams. From these, however, the natives obtain enough to make their earthenware pots. No loam or rich soil of any kind exists.

No crops really flourish. Cassava grows, though slowly, and this forms the staple food of the people, supplemented by some of the smaller kinds of millet. Indian corn, which requires good deep soil, will not grow.

There is a central hilly backbone, the highest hill being 540 feet above the lake. At some parts the hills descend abruptly to the lake ; elsewhere there are plains half to one mile broad between the hills and the lake shore. These naturally have the best soil, but cassava is planted all up the hills, where any soil exists between the boulders.

Where not cultivated, the land grows brushwood and creepers freely, and small trees, the leaves of which form the food of the goats and cattle during the dry season. There are no large trees except Baobabs, which grow to a great size. Probably other trees would also grow big were they not constantly being cut for firewood, which is very scarce. Fish are plentiful in the lake, all round the island, and during the wet season some are also caught at the mouths of the streams. Together with cassava flour, fish (either fresh, smoked, or sun-dried) is the main article of diet.

There are no permanent springs or rivers on the island. Owing to the sandy nature of the soil the rain rapidly soaks in, and an hour after heavy rain the surface of the ground is quite dry. There is practically no subsoil water till the lake level is reached. No ordinary pit dug inland remains full of water, not even during the wet season, but of course the roots of the trees and shrubs must reach moist soil all the year round. During the wet season there are streams; these run from January to June, but dry up between June and September. Some of them are from half to three-quarters of a mile long, but a great majority are quite short—only 100 to 200 yards long. Above them there is a dry watercourse where water only runs during a rain storm; after the rain is over, the water soaks into the sand to reappear as a spring close to the lake. These streams throw up small bars at their mouths, and often behind the bar is a pond or swamp which forms a favourite breeding-place for mosquitoes. As there are no streams or ponds from September to December there are no breeding-places (unless the lake or chance pools dug on the lake shore serve as such), hence probably the mosquitoes must live on in native houses during this period.

The streams are not used for drinking water; all water is drawn from the lake. The lake shore is clear and sandy or rocky, without reeds or water plants growing in it, so that the water is clean.

Unfortunately the natives use the rocks and also the dry watercourses as latrines. During the dry season the hot sun probably does much to destroy all germs, but in the wet season sewage must get washed down into the lake, and the water must become contaminated, though as a matter of fact very few water-borne diseases occur on the island.

There are no beasts of prey on the island. There are a few monkeys, conies, otters, etc. Crocodiles are present in the lake, but on account of the deep water and lack of cover they are not dangerous. Gulls, divers fish, eagles, hawks, and pigeons are plentiful.

The population was estimated in 1885, at 2,600. The inhabitants came some from the western shore of the lake (Nkata Bay, Chizi, and Bandawe), some from the eastern. These fled from the slave raids and sought sanctuary at Likoma. The island was overcrowded, and though some still had gardens on the eastern shore of the lake, it could barely produce enough food.

Of late years, as the country has become more settled, a number of families have returned to their original homes, and now (1904) the population certainly does not exceed 2,000 souls.

The island was chosen as the site of a European station mainly on the same ground of safety, though the excellent harbour was another reason. Its barrenness is a great disadvantage. All firewood, timber, grass, and bricks for building, and most of the food for native schoolboys, have to be brought from the mainland by boat. Fruit trees grow

very slowly, and bear little fruit, but there is one mango, and there are a few lime trees. In order to maintain a proper garden bed, loam has to be brought over by boat from the mainland, and this scarcely repays the trouble ; it is a better plan to maintain a garden on the mainland and bring over the fruit.

All the native villages are close to the lake shore, most of them in the little plains above mentioned, but some are perched on the rocks. There are no native houses in the central hilly part of the island.

The climate of Likoma is pleasant for nine months of the year, but it is hotter than many parts of the mainland. From October to December it is hot and oppressive, decidedly more so than the mainland, opposite. At this time of the year there is little vegetation, and the ground is scorched. The rocky boulders absorb heat during the daytime and give it out at night, making the night air hot and oppressive.

Range of Temperature.—The following figures are based on observations made during 1899 and 1900, at the Mission Station:

Shade Temperature (in full shade at back of verandah). Highest, 90° F. to 98° F.

Shade Temperature (in full shade at back of verandah). Lowest, 60° F. to 70° F.

Daily Variation. Cold weather (May to August), 65° F. to 80° F.
Hot weather (October to December), 80° F. to 98° F.

Temperature inside a stone house. Highest, 90° F.
Lowest, 70° F.

Average daily variation (inside a house). Cold weather, 70° F. to 80° F. Hot weather, 80° F. to 90° F.

Rainfall at Likoma.—The appended table gives the rainful for the last seven years. There are no records available for comparison from the mainland opposite, nor from any other place in the near neighbourhood.

	1897-8.	1898-9.	1899-1900.		1901-2.	1902-3.	1903-4.
Oct. . .	—	—	·01	No Record 1900-01.	—	—	—
Nov. . .	1·21	—	2·29		—	·09	·38
Dec. . .	11·26	6·33	9·37		3·6	4·28	9·674
Jan. . .	11·41	5·22	7·68		16·8	9·505	13·92
Feb. . .	22·96	20·39	10·35		4·57	6·155	10·305
March .	2·86	9·32	9·99		3·95	5·9	5·34
April . .	2·88	3·4	2·5		·64	·405	
May . .	—	—	1·8		—	·135	
June . .	—	—	·17		—	·05	
Total . .	52·58	44·66	44·16		29·56	29·52	*39·619

* Total to end of March, 1904.

The rainy season lasts, roughly, from December to April.

Mission History.—The Island was chosen as the headquarters of the Mission on the Lake in 1885. The site selected for the station was called Chipyela (i.e. the burning-place of witches). It is some 60 yards from the lake, being equidistant from the two villages of Mbamba and Ngani. The ground slopes gradually upwards and the station is 100 feet above the lake. It is sheltered from the north and west by the hills which form the backbone of the island, but is exposed to the east and south.

The original site was a small piece of ground 100 yards square. Here were built the European houses, boys' dormitories, church, schools, etc., and just behind were the houses of some native retainers, with their wives and families. The European houses were built of reeds (wattle work), but they were not daubed over with mud (as is usual in native huts). There were no windows ; light and air (and wind) were admitted by having an open space all round between the walls and the roof. The first stone buildings were erected in 1889, and between then and 1892 others were built, but they were used for schools, stores, etc., and not for Europeans, as Archdeacon Maples contended that reed houses were healthier as well as being more native !

The general standard of living was ascetic : salt pork, salt beef, no jam, and very few luxuries of any kind. There was a general disregard of hygienic principles, and almost complete ignorance of the special precautions necessary in a tropical and malarial climate, and the teaching as to health that was laid down as the supposed result of experience was often fallacious.

In October and November 1892 two big fires destroyed nearly all these reed houses, and the members of the Mission were for a time almost houseless.

Gradually the tide of opinion at home set against this attempt to live like natives without due regard for hygienic precautions, and the same ideas gradually permeated the Mission, and were further instilled into it by the new members.

In 1894 the Medical Board was formed, and, acting on the advice of Bishop Hornby, they made a strong recommendation that stone or brick European dwelling-houses with doors and glass windows should be built ; a recommendation which was accepted by Bishop Maples and which was put into effect soon after his death.

The first stone dwelling-house was finished in 1896, and the first glass windows were put in during 1897. Between 1897 and 1900 stone dwelling-houses with windows were built for all Europeans.

The type of house steadily improved. As transport became easier and glass plentiful the windows were enlarged. In 1902 an attempt was made to make the houses both ant-proof and draught-tight by placing zinc on the top of the walls under the roof ; prior to this, the ants had been forestalled by raising the roof on brick pillars which were capped with

pieces of tin; this arrangement, however, let in wind all the way round. Coincident with these improvements in housing, the general standard of living and comfort was greatly raised. A good supply of sick-comforts was obtained, the European hospital was improved, and from 1899 onward there was always either a doctor or nurse on the island. There was also a more general recognition of the need of obeying the laws of hygiene.

The site of the Mission Station and the harbour and the sovereign rights over the island were bought in 1900. This made a material difference to the position and power of the Mission, and it enabled the station to be extended at will. In 1898 the little group of retainers' houses was moved away from the back of the station and built 100 yards nearer the lake, towards Ngani village. The same year a sub-station was opened at Nkwazi, at the south end of the island. A stone dwelling-house was built by the Rev. E. B. Smith on a little hill 250 yards away from the village and 60 feet above the lake, on a spot sheltered from the full force of the south wind by a small mass of rocks. The school and teachers' house were built in the village below.

During the next four years a church was built which was finished in 1903. Since its institution Nkwazi has been occupied by the Rev. E. B. Smith, but other members of the Mission often go over for a day or two's rest, for which it is well suited.

Unfortunately, however, the site chosen is not satisfactory. It is too near the village, and there is a stream (in the wet season) within fifty yards of it; also, the house is draughty and unsatisfactory from a health point of view.

I.

HEALTH RECORD OF LIKOMA. 1885—1898.

(Compiled from the Mission Magazines, the Office Records, information obtained from present or former members of the Mission, and such medical statistics as could be found.)

1885-1888.—For the first few years the health record of missionaries at Likoma was varied. The Rev. C. Maples and Mr. J. Williams, who had been ten and eleven years in the Rovuma country, and who were acclimatized before their arrival at Likoma, had good health, with only occasional attacks of fever; but Mrs. Swinny, Rev. L. H. Frere and Mr. C. Alley all had frequent attacks, and in about three years became run down and anaemic. Mrs. Swinny was invalided home at Easter, 1888, but died from "fever and exhaustion" during the voyage home. (Her child, aged four, had died previously after one year of life at Likoma in April, 1886.) The Rev. C. Swinny died at Bandawe, February, 1887,

after having been one and a half years at Nyasa ; part of this time was spent at Likoma, part on the *Charles Janson* steamer, and part on two visits to the Magwangwara. Mr. A. was invalided home after six months as an unsuitable subject for Africa.

1888–1892.—During this period the health record was similarly varied. Four ladies were at work. Two of these had already worked in Zanzibar, and were to some extent acclimatized ; but all four had fair health. The Rev. C. Maples as usual enjoyed good health.

The Rev. B. and Mr. C. were invalided in 1892, both being very anaemic and having enlarged spleens. Mr. D. was invalided, after seven months' residence, for frequent attacks of fever in September, 1889. Mr. E. had blackwater fever after one year's residence and was invalided, but died on his way home from " fever and exhaustion."

In October and November, 1892, occurred the fires, which caused the withdrawal of the ladies, owing to lack of house accommodation, and a time of great hardship for the men. Mr. F., who had only been out nine months, but had frequent fevers, was also sent home.

During 1893 the houses (still only reed huts) were rebuilt, and in October, 1893, the ladies returned.

1893–1895.—This was an extremely bad period as regards health. A great deal of alarm was caused in England, and Likoma came to be regarded (quite erroneously) as an essentially unhealthy station.

The bad health record can be partly accounted for by the following considerations : First, a number of new members who were quite unacclimatized came out, and, further, some of these were constitutionally unfitted, and would not have been passed by any Medical Board. There were also the bad housing and the disregard for hygienic precautions above mentioned.

Secondly, there occurred during 1893 four cases of paresis. These were regarded as due to malarial neuritis, the more probably they were sporadic cases of beri beri. The Rev. G. and Mr. H. from Likoma, and Mr. I. from the *Charles Janson*, were invalided home for this cause, in each case after eleven months' residence. This complaint came to be spoken of as " Likoma paralysis," and was at the time thought to be due to the extremely unhealthy and malarial character of the island. The suggestion that they were cases of beri beri seems however more likely. The Rev. J., who arrived at Likoma in November, 1894, and had frequent slight attacks of malaria, was supposed to have paretic symptoms after six months, but they subsequently disappeared ; and Mr. K., who was invalided home after three months at Likoma as constitutionally unfitted, was also supposed to have paresis. Probably both these were neuroses, easily accounted for by the fact that " Likoma paralysis " was the fashionable disease.

Bishop Hornby, who arrived in April, 1893, had poor health, and was invalided home in February, 1894, and later in the year he resigned.

But, making all allowances, the health record was bad. Messrs. G. H. I. all had a good deal of "fever," and Mr. L. was invalided after frequent fevers in 1895. Mr. M. died in May, 1894, after a year in Africa from "remittent fever with exhaustion and hyperpyrexia." Mr. N. had blackwater fever about June, 1894, after fourteen months' residence, and a second attack from which he died in January, 1895. Miss O. had blackwater fever after two years in October, 1895, and was invalided home.

In August and September, 1895, three accidental deaths occurred; the Rev. G. W. Atlay was killed by the Magwangwara, and Bishop Maples and Mr. J. Williams were drowned in the lake. These losses, together with similar ones in the Zanzibar diocese, caused great uneasiness at home. The Medical Board was constituted, and intending candidates were henceforth examined before being accepted. Acting on the advice of Bishop Hornby, they further urged that stone dwelling-houses should be built throughout the Mission.

1896–1898.—These more reasonable ideas gradually made themselves felt at Nyasa; stone houses were begun, the attempt to live an ascetic life, or to live like the natives, was gradually abandoned, and there was a more general acceptance of the laws of health, although little was yet known of the special precautions against malaria which should be observed. These ideas, however, only won their way gradually, and a good deal of carelessness and foolhardiness remained.

In 1896, the Rev. P. E. Faulkner was invalided after two attacks of blackwater fever in less than a year. Nurse P. had fair health, but was supposed to have had a slight attack of blackwater fever after one year's residence (June, 1890). Miss Ellershaw died from blackwater fever after twenty months (during which time she had frequent fevers) in July, 1897. Mr. A. Dutton, who worked on the *Charles Janson* at Likoma, had frequent attacks of fever, and after two and a quarter years had blackwater fever, and two months later a second attack from which he died September, 1897.

In February, 1897, Nurse Q. was invalided home after four months as constitutionally unfitted. Nurse R. was invalided after ten months on account of prolonged pyrexia; four months later she contracted blackwater fever in England.

When this nurse was invalided, the only other lady had to go home with her, and the station was again closed for ladies, and it was decided to build sufficient stone dwelling-houses for them before they returned.

SUMMARY, 1885—1898.

Total number of workers, 38. Of these, six were more or less acclimatized by residence in the Zanzibar diocese; the rest were new members.

Total number invalided, 15. These may be divided as follows:—
Four constitutionally unfitted who did not return.
Three might have returned but withdrew.
Four were allowed to return.
Four were forbidden to return.

Total number of deaths, 8.

Statistics of haemoglobinuria or blackwater fever.

Total number of patients, 8.
Total number of attacks, 12. Two patients had two attacks, and one, three attacks.
Deaths, 4, i.e. a mortality of 33⅓ per cent.

II.

HEALTH RECORD OF LIKOMA. 1899—1903.

During this period there was the most remarkable improvement in health. There were no deaths. No one was invalided and there were no cases of blackwater fever among the workers at Likoma. A similar general improvement took place throughout the whole diocese.

This improvement is partly accounted for by the fact that the period of pioneer work was for the most part at an end. The country was settled, transport arrangements were better and more regular, so that supplies and stores could be more easily obtained. This made it easier to maintain and further improve the general standard of living. A somewhat similar general improvement in health was observed throughout the B. C. A. Protectorate, amongst officials and traders alike, whereas the years 1897 and 1898 had had very bad records.

But another and more far-reaching cause is to be found in the fact that the recommendations of the Medical Board were being carried out. There was a rigorous examination of candidates before they were passed for work in Africa. Also, in 1899, the "Two years' rule," * i.e. the rule that the *first* furlough should take place at the end of the first two years of completed service in Africa instead of at the end of the third year, as heretofore, came into operation. Further, the recommendations as to housing had been, or were in process of being, carried out, and speaking generally there was a great decrease in foolhardiness, and a real attempt on the part of members of the Mission to live in a manner suited to a tropical country.

* See page 8.

Again, satisfactory hospital accommodation was provided and an adequate nursing staff was maintained, with the result that patients were regularly nursed during attacks of fever, instead of being encouraged to ignore them as had previously too often been the case.

Lastly, great and far-reaching discoveries were made in the scientific world, which demonstrated the means by which malarial fever was propagated, and indicated the special precautions which should be adopted in order to guard against it.

The gain to the Mission by this improved health record is undoubtedly very great. Members have been able to carry on their work with little interruption from illness. Also, when they have arrived home from furlough, they have been for the most part in good health. This latter point should enable them to be better able to undertake work for the Mission while in England, and also to spend less time on furlough than has hitherto been customary; while the encouragement which it gives to friends and relations is a matter not to be lost sight of.

Turning to consider this period in more detail, we may divide it into two sections.

1899–1901.—Compared with all previous records the health of this period was remarkably good. There was a large number of new members who were quite unacclimatized, and all of these suffered from occasional attacks of malaria, but the cases were for the most part of slight or moderate severity and yielded readily to proper medical treatment and nursing. Three members suffered from frequent attacks, but only for a portion of their time (viz. about six months). Two old members of the Mission had indifferent health, but they had both somewhat overstayed their time, and were not inclined to take precautions.

Incidentally it may be mentioned that two cases of iritis occurred as complications of malaria, possibly a true malarial iritus. In neither case did permanent damage result.

1902–1903.—The health record during these two years was quite exceptionally good. There were no severe attacks of malaria, and almost all members had long periods of perfectly good health. (Mr. T., who remained on during the first nine months of 1902, was the only member who had bad health.) Probably this remarkably good record is partly accidental and not likely to continue on quite the same level; it is partly accounted for by the very small rainfall of these years, materially reducing the number of mosquitoes; but it is also to be hoped that it is partly due to the recognition of the recent discoveries with regard to malaria and their application to the Mission station; and the benefit resulting from this latter cause should be permanent.

TABLE SHOWING THE MONTHLY INCIDENCE OF MALARIA, 1899—1903.

The subjoined figures give the total number of cases of malaria occurring among the European residents at Likoma during each month over a period of five years.

Owing to the small number of residents these statistics cannot have any real scientific value, but they are given as being suggestive as far as they go.

January 9	Total for first 3 months, 24.	Total for first 6 months, 58.
February 6		
March 9		
April 9	Total for second 3 months, 34.	
May 15		
June 10		
July 5	Total for third 3 months, 17.	Total for second 6 months, 23.
August 4		
September 8		
October 2	Total for fourth 3 months, 6.	
November 1		
December 3.		

Hence it appears that the first six months of the year are much more malarial than the last six, while the last three months (in spite of their being very hot and trying) are almost free from malaria. Also the most malarial period is the second three months. These facts find an explanation in the observations on anopheles (see later). During the second quarter they are breeding freely, there is plenty of cover (grass, etc.) in the streams, and they are not flushed out by heavy rains. Also the anopheles have had time to become infected with malarial parasites, and the south wind which would bring them from Ngani to the Mission station is prevalent during this season. During the next quarter anopheles breeding-places disappear, and the malarial incidence falls, while during the last quarter there is scarcely any malaria and anopheles are scarce. (See Observations on Mosquitoes.)

OBSERVATIONS ON MOSQUITOES

In the Neighbourhood of the Mission Station.

1899—1903.

General Prevalence of Mosquitoes.—Mosquitoes are never very prevalent at the Mission Station (Chipyela), nor are they at any time a great nuisance.

During the wet season (December or January to April) *culices* are present in considerable numbers, and are sufficient to be an annoyance. They are persistent in their attacks, and often bite in houses or on the verandah during the daytime. They are particularly troublesome in the evening. For the rest of the year they are practically absent, only an occasional stray one entering one's house.

Anopheles are never seen on the station in large numbers. They appear rather later in the wet season, at the end of February or the beginning of March, and are observed occasionally up till May or June. They seem specially prone to enter houses at night after lights are out, and most of those observed have been caught remaining in houses in the morning.

If a bad type of mosquito net (without calico round the bottom) is employed, full fed ones can often be caught in the morning asleep outside the net.

A noticeable point is that, in a series of observations made in 1900, whereas culices were caught in the proportion of eighteen females to twelve males, anopheles were in the proportion of twenty females to one male. (For explanation see notes on breeding-places.)

Apparently there has been a decrease in the number of anopheles on the station during 1902–3, as compared with 1899–1900. This may be due to the fact that 1902–3 were much dryer years, or it may be partly due to chance. There were certainly fewer culices during the dry years, but that is easily explained. (See notes on breeding-places.)

Anopheles are more plentiful in the ladies' quarters than elsewhere on the station. This is accounted for by two facts (1) the south wind would bring them here from Ngani, and (2) there is a chain of houses which would facilitate their flight. (See p. 25.)

Breeding-places of Mosquitoes.—Most of the above-mentioned facts are easily explained by observation of the breeding-places. *Culices* breed on the station in old tins, pots, etc., kept filled by the rain, i.e. in artificial collections of water. Hence the prevalence corresponding with the rainy season, and their number depends on the constancy of the rain. Hence also the approximately equal number of males and females which enter houses. If these tins, etc., be cleared away, there is a marked decrease in their numbers.

Culices also breed in streams and ponds near the lake, but probably few of these reach the station.

Anopheles.—*The reare no breeding-places on the Station.* They breed in natural collections of water, and owing to the sandy nature of the soil none such exist nearer the Mission Station than the neighbourhood of the lake, which is 600 yards distant, and 100 feet below the Station. The distance is the same to both Ngani and Mbamba (see map, p. 12).

There are no permanent streams running into the lake all the year round ; but in the wet season there are many short streams, often not more than 100 yards long, and a few longer ones of half a mile or more. The short streams start as springs in the sand ; above the spring there is a dry sandy watercourse where water only runs during a shower of rain. The time that these springs start running varies according to the amount of rain ; it may be any time between December and the beginning of February. A heavy shower of rain brings down a flood of water which flushes out the watercourse, and often cuts out quite a new channel through the sandy beach to the lake, so that the last part of their course is variable. At such times the streams bring down much sand and throw up a bar at their mouths, behind which the water often collects as a pond. The ordinary

flow of water may escape by soaking through this bar, but a rush of water cuts out a fresh passage.

If there are frequent storms of rain, and the course of the stream is straight and not blocked by obstacles or vegetation, it may keep a clear-cut course to the lake without the formation of a bar and a pond behind it. If the overflow of the stream into the lake is good, fish come up in order to spawn, and young fish abound in the stream. These latter destroy the anopheles larvae.

The streams cease running about April or May ; but the bar-ponds at their mouths remain. At first these are below the level of the lake, and they only dry up as the lake falls. By August they are quite dry, and they remain so till the following December or January. Anopheles breed in these streams, unless prevented by (1) a good flow of water or an occasional flood, or (2) the presence of small fish.

The conditions that favour them are (*a*) much vegetation ; this prevents the access of fish and hinders the flow, and (*b*) a crooked course, especially if there are holes along the edges, as occurs where a stream flows through a mass of reeds.

At the end of the wet season the flow of the stream decreases, the occasional floods cease, the vegetation increases, and the young fish either find their way to the lake or die off, hence the conditions are more favourable for anopheles. In May and June the bar-ponds form ideal breeding-places (cf. the special prevalence of malaria during these months, monthly incidence of malaria, see p. 22). Other subsidiary breeding-places exist during the wet season close to the lake, e.g. pools in old canoes or among rocks formed by back eddies from the waves (see p. 26, map of Ngani marked ▪ Pools also occur close to the lake shore which are dug by the natives. They bury their cassava in holes in the wet sand, and often, when they dig it up, small pools are left. In such pools anopheles larvae can often be found in numbers, but they are unsafe breeding-places, for if a wind raises any waves on the lake they are apt to be washed away. Similar pools sometimes occur in the beds of streams near their source, especially where they are more or less blocked by bushes or other obstacles, and these are favourite breeding-places, as fish do not generally get so high up, but of course they also are apt to be washed clear by a rush of water after a storm of rain.

Chipyela (the Mission Station) is 600 yards from the lake, and hence about 500 yards from the nearest anopheles breeding-grounds. Anopheles breed freely, and the preventive measures mentioned below will never be completely successful in stopping them, though they may caus some diminution in their numbers. There are also native huts close by so that they can readily become infected with malarial sporezoits.

Between the Mission Station and Mbamba there is only one house, a

schoolboys' dormitory (150 yards from the station and 450 from the lake), and it will shortly be demolished. Towards Ngani, however, there is a string of houses of retainers of the Mission; for (unfortunately from the mosquito standpoint) when the houses were moved from just behind the Station in 1898 they were rebuilt here; they are distant from Chipyela 50, 100 and 450 yards, so that the greatest distance without any house is only 350 yards.

As mentioned before, it is probable that most of the anopheles which reach the Station come from Ngani (hence their prevalence in the ladies' quarter, which is the part of the Station nearest to Ngani); they are helped to cover this distance by the south wind, and also by this string of connecting houses. *Hence on the first opportunity the latter should be moved.* Very possibly the anopheles do not cover all the distance in one flight, they may use these houses as resting-places perhaps for the whole day and then proceed next night. The absence of male anopheles from the Station (which was noted above) is obviously due to the fact that they cannot fly so far. The houses are marked on the map.

Details of the streams, etc., at Mbamba and Ngani. See plans, p. 26. In 1899 the conditions at Mbamba and Ngani were as follows:—

At Mbamba were two streams, both with tortuous courses. Each ended in a pond kept in by a bar which was strengthened by a growth of reeds. There were also two watercourses where water ran only during rain storms. In both the streams anopheles bred freely. (Improvements were made in 1900, see p. 27.)

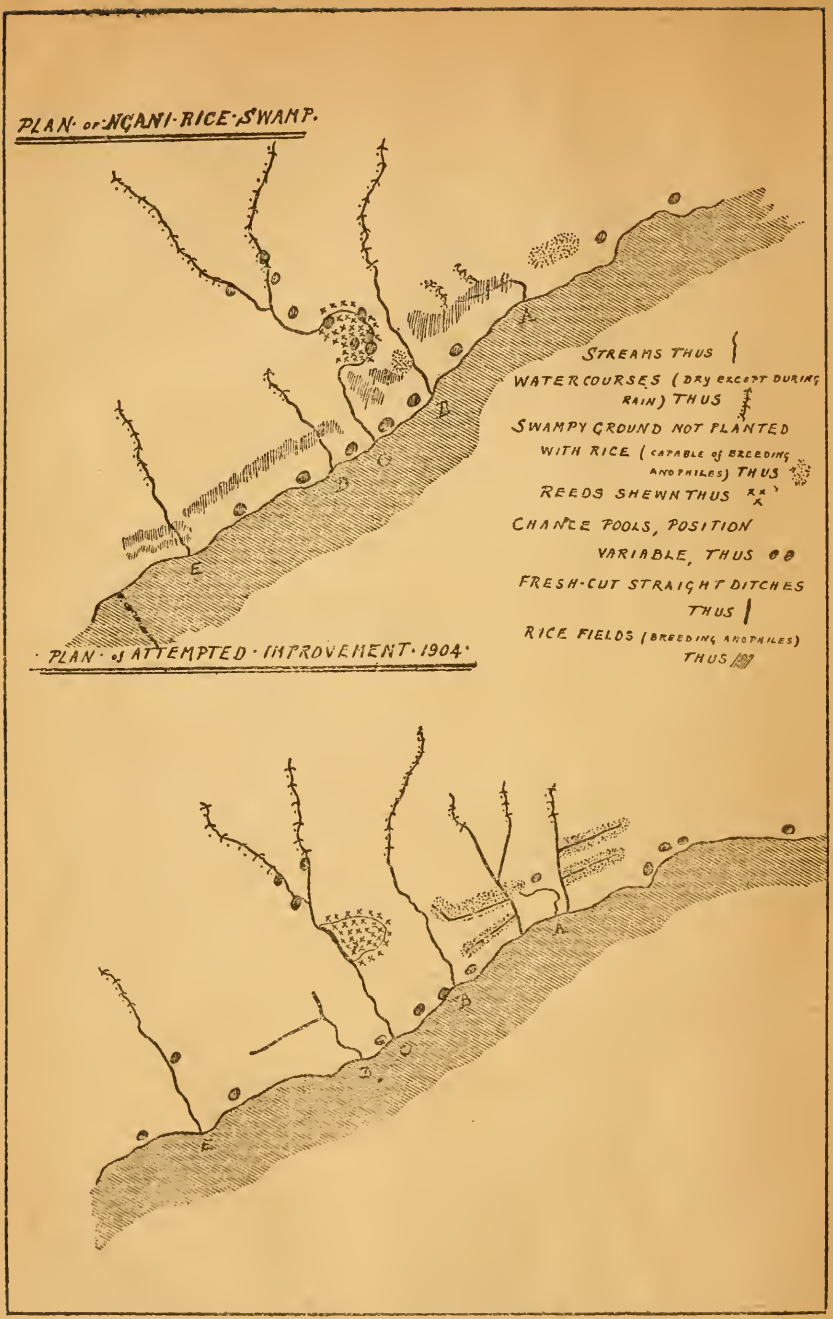
At Ngani the breeding-grounds were more extensive. There were five streams, four quite short, (*C* on map and plan) 300 yards long.

The first, *A*, began in a hollow which was planted with rice which interfered with its flow. The second, *B*, was short and straight, but some of its waters were diverted to a rice field between it and *C*.

The biggest (*C*) had a good flow, but sixty yards from the lake it had a very curved course among reeds, which checked the flow and caused the formation of numerous pools suitable for anopheles to breed in. Above this curve it had a deep cut sandy bed. It was about 300 yards long at the height of the rainy season. Pools are present at times high up in this bed at some distance from the lake.

D and *E* were small streams, blocked with rice, which flowed out of a low-lying swampy hollow also planted with rice. In dry years this hollow contains little water, but in wet years it is decidedly swampy. All the streams had bar-ponds of greater or less extent at their mouths. This rice area with its streams was the main anopheles breeding-ground, but of course there were also the chance pools near the lake above mentioned.

From August to December no anopheles breeding-grounds were observed. The only possible breeding-places being these chance pools near the lake



PLANS OF NGANI RICE SWAMP AND ATTEMPTED IMPROVEMENT, 1904.

shore. Probably they do not breed during this period but live in the native huts in small numbers.

Attempted Improvements.—(See plan.) The object aimed at was to make straight streams with a clear course, so that they could be flushed out with rain, that they should not form a bar and bar-pond, and that fish could easily get up to spawn.

Mbamba.—In November and December, 1900, the two streams at Mbamba were straightened, the reeds at their mouths being cut away so as to give a clear course to the lake. The edges of the larger stream were lined with brickbats, and the hollow where the bar-pond had been was filled up. These measures were on the whole decidedly successful. The streams required to be cleared of grass, and their edges attended to from time to time. The number of anopheles breeding at Mbamba was apparently reduced. In view of the fact that boats from the streams land here, there must always be some traffic to and from the lake shore at night: this is of decided importance, even though few of the Mbamba anopheles manage to reach the Mission station.

Ngani.—During 1903 the rice-growing swamps were bought up, and in January, 1904, an attempt was made to drain them. A straight course, avoiding the curve in the reeds, was cut for the stream *C*. Straight ditches with side branches were cut to drain the two main rice swamps as in the plan. No rice was planted, but bananas and pineapples were put in, so as to occupy the ground and prevent the natives from planting rice again another year. As far as can be seen these measures promise well. There is less swamp, the drains have a clearer outflow and contain fish.

After the rainy season is over and the flow in the streams has ceased, but when the bar-ponds remain and form important breeding-places (i.e. during the months of June and July), something can be done by treating these ponds with paraffin. This plan has been adopted from time to time, but it can only have a limited application, and would be of no value while the stream is running. Further, paraffin is very costly on Lake Nyasa, and can only be used in very small quantities.

The above measures have been undoubtedly beneficial, but they can only be partially successful. *The numbers of anopheles at Mbamba and Ngani may be reduced by their means, but they cannot be exterminated.*

The irregular course of the streams through the sand, the sudden rushes of water which quite alter the course, and, above all, the rise and fall of the lake level, with the formation of bars and bar-ponds at the mouths of the streams, effectually prevent any radical measures. The measures which have been adopted are partly successful, but contant attention to the ditches will be necessary, or else they will soon get blocked up and useless. Also other breeding-places will always exist in the pools near the lake shore, etc. In short, the *lake shore will always supply a breeding-*

ground for anopheles, and these will always be able to acquire infection from the native children who live close by.

CONCLUSIONS AND RECOMMENDATIONS.

The *Culices* which reach the station are almost all bred locally. They can be prevented by the measures already enumerated (see p. 23).

The *Anopheles* which reach the station come from the lake shore in the neighbourhood of the villages of Mbamba and Ngani, particularly the latter. A considerable percentage of these are probably infected with malaria. The number which manage to reach the station is, however, small, on account of the distance of over a quarter of a mile which separates the station from their breeding-grounds.

1. The main point to be aimed at is to *maintain this isolation*, and to improve it by removing the connecting houses, viz. the dormitory between Chipyela and Mbamba and the string of houses towards Ngani (see map, p. 12, marked thus ×) on the first possible opportunity.

There is a suitable flat piece of ground behind the station towards Madimba (marked thus × on map). This is only 150 yards from the station, but it is further from anopheles' breeding-grounds, and is, moreover, separated from the lake by a small hill, which would still further tend to prevent them from reaching it. It would be a very suitable site on which to rebuild the dormitory and the retainers' houses when they are removed.

2. *On no account should the building of any new houses between the Mission and either Ngani or Mbamba be permitted.*

3. Any considerable extension of the station, if such be contemplated, should not be made on the present site, as a quarter of a mile is not sufficient for complete isolation. It should be a quarter of a mile or so *further inland*. There is an excellent site on the path towards Kuyu higher and more bracing than Chipyela. This spot is about half a mile from the lake, and would probably be absolutely free from anopheles.

4. Further, in order to diminish the risk of those anopheles which reach the station and hang about it, becoming infected on the spot, only boys and girls should sleep on the station, and all married natives with children should sleep in the villages. This rule is, as a matter of fact, in force (except as regards the houses of retainers above mentioned). Mission considerations may demand the presence of one married teacher on the station, but the number should always be the least possible.

5. Lastly, *the comparative healthiness of the station, and the very malarial character of the lake shore, should be constantly remembered by all workers at Likoma ; and after sunset the neighbourhood of the lake should be avoided as far as is practicable.*

NKWAZI SUB-STATION.

Mosquito Observations.—The house is 300 yards from the lake and 60ft. above it. It is about 200 yards from the native huts of the village.

Anopheles breed near the lake shore under similar circumstances to those described above, and the house is not sufficiently far away to prevent them from reaching it in considerable numbers.

A stream flows past the house within 50 yards of it. It is over a quarter of a mile long in the wet season, and flows in a deep-cut rocky bed. Anopheles would not be able to breed here (except at its mouth, where it forms a bar-pond) during the height of the wet season, as the rush of water after heavy rain would wash them away. At the end of the wet season, when the flow of water is less and until it dries up (April–June), they breed in rock pools in its bed, and here they are safe from young fish, which cannot get up this part of the stream. This stream is, however, of secondary importance, and the main source of anopheles is the lake shore.

Conclusions and Recommendations.—Nkwazi is decidedly more malarial than Chipyela, owing to its being less isolated. If any extension occurs (it has often been suggested as the best place for a Theological College), it is most important that this isolation should be increased.

This could be attained by using the present house only in the day time as a library and lecture room, etc., and building the European dwelling-house or houses 200 yards further from the lake at *N* on the map. There is a nice sheltered site here (see p. 12).

The native dwellings in connection with such an establishment would be best placed at K on the other side of the stream, as this would reduce the number of stream-bred anopheles that would be likely to reach the European house. It would be better still to build the native dwellings in the village, but this would probably not be practicable on Mission grounds.

The rock pools in the stream would require to be treated with paraffin between the months of April and June.

SOME GENERAL OBSERVATIONS ON LIKOMA.

Independently of the Malaria question, there are a few points connected with the health record of Likoma that demand attention—

1. *The barrenness of the island* is a great disadvantage, for it limits the supply of fresh vegetables, and to some extent of milk, while fruit cannot be obtained on the island. This difficulty has been met by the use of the garden planted at Utonga, on the mainland opposite, by Archdeacon Johnson, and also lately by a new garden which has been planted at the College. With good management of these gardens and of the means of transport, probably Likoma could be as well supplied with fruit and vegetables as any other station.

2. "*Likoma paralysis.*" The heat of the ground, and its stony, rough, hilly character are very trying to some people, especially to the ladies. The worst months are October to December, especially the latter, if rain is delayed. Some workers suffer from oedema of the ankles, in consequence. In the case of one worker, on three occasions, visits to Likoma, each of about two months' duration, have caused a curious train of nervous symptoms. Attacks of loss of sensation in the legs (described as a feeling of tightness and then a feeling as if there were nothing below the knees) occur suddenly, so that it is difficult to keep from falling. The feeling passes off gradually. The attacks generally occur in the morning when kneeling, or getting up after kneeling. (There was also some oedema of the ankles in the evenings, with aching pain, but this has occurred at other stations, and is partly due to varicose veins.) On examination on one of these occasions knee-jerks were absent, but there was no intramuscular tenderness. Knee-jerks returned after the patient left Likoma and returned to Kota, and the subjective symptoms also disappeared. The signs and symptoms seem to suggest nerve exhaustion without actual neuritis.

Other members of the Mission have, from time to time, complained of feelings of weakness and numbness in the legs, and the cases of J. and K. (see p. 18) were possibly of similar nature. In most of these cases, however, there is nothing to show that the symptoms were anything more than subjective, as there is no record of the condition of the knee-jerks. (K. on return home had increased knee-jerks and ankle clonus, suggesting an hysterical condition.)

Such cases have been called "Likoma paralysis" in the Mission.

The most interesting question is the relation of these cases to the supposed cases of beri-beri, which occurred in 1893–94. No other cases in any way resembling beri-beri have occurred since; nor have any been observed anywhere on the lake. It is possible that they were not beri-beri, but were exaggerated cases of the above condition; but one strong argument against this suggestion is that one of the sufferers from supposed beri-beri was not a resident at Likoma, but was working on the *Charles Janson.*

3. *Chronic ulcers and "fever sores."* It is a noticeable fact that these complaints, which seem to have been very prevalent in the early days, find no place in the health record of the last five years. Probably they were due partly to a depressed state of health and general debility and anæmia, but partly also to neglect and want of intelligent surgical treatment.

PART II.

Chisumulu.

Physical Characteristics.—The island lies about seven miles west of Likoma. It is right out in the lake, and gets no shelter from Mala point. In shape it resembles a tadpole. It consists of a big hill 500 feet high, surrounded by a very narrow belt of level land, and of a tail of flat land two miles long. Villages are built all round the hill and also on the "tail." The hill is cultivated with cassava right up to the top. The level ground is very stony and rocky. Between the stones the soil is fertile, and, in places, swampy. Rice, sugar-cane, millet and Indian corn can all be grown in places.

The population is about 800. Large quantities of fish are caught. Much of this is taken to Msumba, where it is exchanged for flour.

Mission History.—Work was begun here by Mr. J. Williams at Chiteko, at the north end of the island, in 1889. He remained here alone till 1893, when he went for furlough, and was succeeded by the Rev. G. W. Atlay. The latter was invalided after blackwater fever in September, 1893, and the Rev. E. B. Smith succeeded him, remaining until May, 1896, when he had to return to take charge of Likoma. He lived at Chiteko, but he also built the Mission station at Same. For the next two years Chisumulu was under the *Charles Janson*, and was worked as a lake-side village. In June, 1898, Mr. Smith returned, and was stationed at Nkwazi (Likoma Island), whence he went over by boat to Chisumulu once a fortnight, generally staying one or two days. From September, 1902, till 1903, the Rev. W. B. Suter visited the island.

While Europeans were living on the island, the buildings were all wattle and daub. Between 1899 and 1902 stone schools and churches have been built; but the European dwelling-house is only a stone shed, without doors or windows.

It is probable that Chisumulu will always be worked as a sub-station of Likoma, and that it will not again be occupied as a European station, certainly not by one European alone.

Mosquito Observations.—As it is not now a European station, no detailed observations have been made.

Mosquitoes are plentiful in the wet season.

Anopheles probably breed freely in the streams, in pools among the rocks, and in the rice fields.

The villages are quite as malarious as the lakeside villages at Likoma, and probably more so.

The present Mission stations at both Same and Chiteko are quite close to the native villages.

No healthy European settlement could be made on the island, unless it were well up on the hill, above the villages.

HEALTH RECORD (Summary). 1889-1896.

The number of European residents is too small for statistics to be of any value. Two, who were acclimatized, had good health ; one, who was not, had several attacks of blackwater fever.

ST. MICHAEL'S COLLEGE.

Physical Characteristics.—The College is built on a small hill overlooking the lake, situated about midway between the villages of Kango and Utonga. In front and on the two sides, it rises sharply to a height of sixty feet; behind, it slopes gradually upward, for two hundred and fifty yards, to a level top ; beyond this it again slopes sharply down.

The country behind rises gradually in wooded hills, intersected by small valleys and grassy plains to a plateau some 1,500 feet above the lake.

The foot of the College hill is about 200 yards from the lake shore, which is sandy and is fringed with close growing reeds.

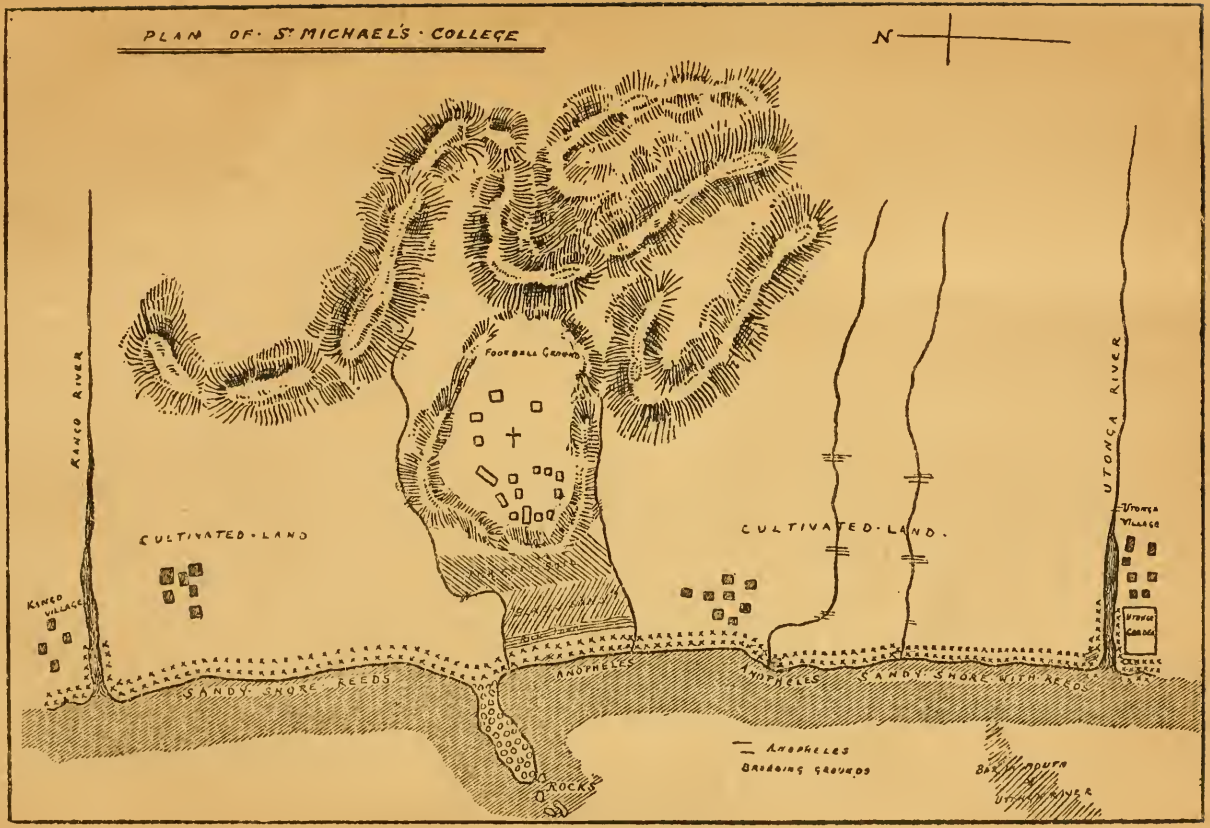
The hill, and also the frontage down to the lake shore, has been bought. The hill itself is rocky, composed of granite and shale, with gravelly or clayey soil. It is covered with small trees and with grass, which grows to a considerable height (six or seven feet) in the wet season.

The belt of level land at its foot, which, as above mentioned, is very narrow (only 200 yards wide) at the College, widens out on either side towards the Kango and Utonga rivers, distant respectively about one half and three quarters of a mile. The soil is very fertile and it is cultivated by the natives, who grow cassava and Indian corn.

The wooded hills and plains of the country behind have, in places, been cleared and planted with millet. Buck and baboons abound, and do much damage in these gardens, while leopards and hyaenas are common, and, when the grass is high, between April and July, they roam close to the precincts of the College.

The College hill is right opposite Nkwazi, at the south end of Likoma. It is about six and a half miles distant from the harbour at Mbamba. A reef of rocks runs out from the shore, making a little bay, sheltered from the north ; this affords a good anchorage for boats, but an indifferent one for steamers.

The hill is freely exposed to winds on the north, south, and west, while on the east, the wind blows down from the hills behind, so that they do not



PLAN OF ST. MICHAEL'S COLLEGE.

afford any shelter. It is, however, sheltered by Mala point from the full force of the south wind, as it blows up the lake.

On either side of the hill is a small stream (see plan) with a deep cut rocky bed. These flow during the rainy season, but soon dry up after it is over. To the north there is no other stream till the Kango river is reached at a distance of about half a mile. To the south, there are two streams close together at a distance of 600 and 700 yards respectively, and at three quarters of a mile distance is the Utonga river.

The soil holds water much more than it does at Likoma, and in the wet season the subsoil water is within four to six feet of the surface, even on the brow of the hill. On the other hand, the soil is much more fertile ; there is the possibility of a good garden on the level ground in front, and the Utonga garden is only a mile away.

The climate is more bracing and pleasanter than that of Likoma, especially at the end of the year.

Timber and all building material is within easy reach.

Mission History.—The College was started in 1900, by Archdeacon Johnson. In its first conception it was to be temporary, and to serve until the *Chauncy Maples* was finished and teachers could be trained on board. Early in 1901, however, it was settled that the College should be a permanent institution for training Nyasa teachers, instead of their being sent to Zanzibar.

The site was chosen in February 1900. At this time the later developments of the College were not contemplated, and also the Archdeacon made a condition that it should be close to the lake. On medical grounds a site higher up and rather further from the lake would have been preferable.

The building was superintended by the Rev. C. Davies. All the buildings were situated on the brow of the hill. They were native-built reed houses, but the best of their kind. There were no glass windows, only holes in the walls, but, apart from this, the houses were daubed with mud, and were draught-tight.

In May 1900, the Archdeacon joined Mr. Davies and a start was made with thirty boys. Later in the year, a church was built, and further accommodation was provided for the College School of sixty boys. There was also a full complement of kitchens, food stores, etc. The College was dedicated on Michaelmas Day, 1900.

In October, the Archdeacon was invalided to Likoma, and afterwards left Africa for a time to recruit. In January, 1901, the Rev. A. G. B. Glossop came, and in March, the Rev. C. Davies left on furlough. Mr. Glossop remained in charge until August. The College School was disbanded, but he had charge of the College of thirty boys, and of the villages of Kango and Utonga, which were handed over by the steamer. A glass window was

put in Mr. Glossop's house, but the essential character of the buildings remained unaltered. The Rev. A. G. de la Pryme succeeded Mr. Glossop in August and remained till September 1902, when the Rev. H. Barnes took charge.

In January 1903, Mr. Barnes was invalided to Likoma with blackwater fever, and the Rev. A. G. B. Glossop took charge. Mr. Barnes returned in April and remained for the rest of the year. Mr. Brimecombe was helping from March to July, but for the rest of the year Mr. Barnes was alone.

The number of students was raised to about sixty; but the College School was not re-established. A stone house with good windows and doors (capable of being made mosquito proof) was built for the Principal of the College (see plan, p. 33). It was placed behind the rest of the station, and should be the beginning of an extension backwards, away from the lake.

At the end of 1903, the staff consisted of the Principal and two native teachers. One teacher and also the capitao and watchman were married and lived on the station with their wives and families. There were also a number of servants who were fed, and lodged on the station, besides the sixty students. The buildings consisted of one stone house, church, dormitories, schoolrooms, kitchens, stores, etc., and teachers' houses and retainers.

A new stone house was in contemplation for the layman, who was to live at the College and help Mr. Barnes, and also a guest house.

Health Record, 1902–1903.—The College has been opened for too short a time and the residents have been far too few in number to allow of any reliable deductions being made.

It is certainly more bracing than Likoma, but it would seem to be more malarious. Two cases of blackwater fever have occurred in four years. This may be a pure coincidence, especially when it is considered that one member had been twenty-four years in Africa, and only five months at the College, and the other had been three years in Africa and only five months at the College. On the other hand, it may have a significance.

The provision of proper stone dwelling-houses (a second house for two persons is to be built in 1904) should tend to improve the health record, for, owing to the exposed nature of the site, proper doors and windows are greatly needed.

Another point to remember is that for most of the above period one European was living there *alone*: although he was within easy reach of Likoma, yet this fact was bound to throw additional strain on him. In the future, the regular staff of the College will be two.

Mosquito Observations.—*Culices* breed on the College premises, especially round native teachers' houses, kitchens, etc. Periodic inspections would keep them down.

There are no *anopheles* breeding-grounds on the hill.

The streams on either side of the hill have a deep cut rocky course and

get flushed out during the rains. Hence they can only serve as anopheles breeding-grounds at the end of the wet season and for a month or two after, until they dry up, and it is probable that they are of secondary importance.

At the lake shore, however, where they flow out, each throws up a bar, with a pond behind it, which forms a regular breeding-place. Moreover, owing to the thick fringe of reeds which grow out into the water, chance pools which form suitable breeding-grounds are here specially common on the lake shore. A little to the south, towards Utonga, there is a small village only 300 yards distant from the brow of the hill. Just in front of it, on the lake shore, is an extensive breeding-ground, formed by the bar and pond of the second stream which flows out near it (see map).

Hence there is an anopheles breeding-ground on the lake shore opposite the College, but the anopheles bred here are unlikely to become infected, except through such children as sleep at the College. There is another breeding-place about 300 yards off, with a native village close by, and this is probably the main source whence *infected* anopheles reach the College. The health record would seem to indicate that they do not reach it in any quantity.

It is a great pity that the College was built so near the brow of the hill. A site on the football field would have afforded a distance of a quarter of a mile from the lake and from the above-mentioned village. *All extensions of the College buildings should be in this direction.*

No improvements aimed at preventing anopheles from breeding in the neighbourhood seem practicable. The breeding-grounds are mainly on the lake shore, and at the mouths of the streams. Owing to the variation in the lake level, which is great, on account of the shallow slope of the shore, it would be very difficult to devise any effectual measures.

Conclusions and Recommendations.—As regards *Culices*, the rules laid down above (see p. 23) should be most carefully observed, especially as regards the clearing away of tins, etc., and the clearing of grass from the neighbourhood of the houses. As the houses are set close together, practically all the top of the hill should be kept hoed.

As regards anopheles :—

1. No houses should on any account be built on the level ground between the lake and the College hill, as these would form links in a chain connecting the College with the anopheles breeding-grounds. For the same reason no houses should be built which connect the College with the native village, 300 yards away.

2. All extensions of the College, and all permanent buildings, especially dormitories and teachers' houses, should be placed towards, or even on, the football field, leaving the principal's house as the dwelling-house nearest the lake.

The buildings on the lake side of this should be pulled down as they become disused. There would be no objection, however, to the church, schoolrooms, food stores, etc., remaining where they are, as they are only used during the day.

3. *The number of children sleeping on the station should be reduced to the absolute minimum.* Houses might be provided for the cook, etc., in the village near by; this would be better than having families living on the station.

Also, the fewer workpeople allowed to sleep on the station the better, as every extra native helps to attract more mosquitoes.

4. All disused reed huts should be cleared away, as these harbour mosquitoes.

5. Further protection would be afforded by mosquito-proofing the European dwelling-houses. The principal's house could be thus fitted up as soon as gauze netting arrives, and other houses should be built with this in view.

6. If a suitable opportunity occurred, the ground of the village 300 yards distant should be bought up and the houses moved further away.

General Observations.—(*a*) The garden at Utonga is managed from the College. About half an acre of good ground was added to it in 1903.

There is also a prospect of a really good garden on the level ground, in front of the College itself. Reference to the plan will show that there is a great variety of soil. Close to the lake there is sand, then a belt of rich loam, suitable for bananas and other fruit trees, then, a broad belt of rich black sand, and close to the hill there is reddish clay, which should give the best chance for growing European vegetables.

With a little trouble and supervision, these gardens could amply supply Likoma and the steamer.

(*b*) *Water Supply.*—Owing to the reef of rocks that runs out in front of the College, and also owing to the bar thrown up in the lake by the Utonga river, the College harbour is a small, shallow, shut-in bay, with a sandy shore thickly edged with reeds. The beach never gets well swept by any wind, and the natives use the reeds as a latrine. Hence the lake water at this point is liable to be dirty and infected.

Drinking-water for Europeans should be drawn from beyond the rocks to the North, where the shore is swept by the south wind, and the water gets changed; but it should also *always be boiled.* (These rules are in force.)

Also, the reeds on the shore in front of the College should be kept cut down. This prevents a nuisance being committed in the immediate neighbourhood, and secures rather cleaner water for the natives to drink and bathe in. Unfortunately the reeds grow fast and are difficult to keep in check.

MAP SHOWING THE AREA OF THE WORK OF THE "CHAUNCY MAPLES."

PART III

The Steamer and the Lakeside Villages.

AREA OF WORK. HISTORY OF ITS ORIGIN.

The Revs. W. P. Johnson and C. Janson reached the lake in February, 1882. The latter died a few days later at Chia. Mr. Johnson established his headquarters at Chitesi's, and between 1882 and 1884 he journeyed about exploring, reaching north to the Magwangwara, and south to the Shiré highlands. In 1884, he returned and appealed for the steamer.

The *Charles Janson* was sent out in 1884; she was put together at Matope, on the Upper Shiré, and launched in September, 1885.

Likoma had already been chosen as the headquarters of the Mission. The *Charles Janson* visited stations on the mainland between Chitesi's and Msumba, frequently returning to Likoma, and every three months going down to Matope for stores.

On one such trip down the river she stranded (in September, 1888) and could not get up the river again till May, 1889. Some Mission work was done during this time in the villages on the Shiré near Matope.

Work was gradually extended. Up till 1895, the fear of the Magwangwara drove the people to live in a few large fortified villages. Latterly, since the Magwangwara have been kept in check by the German government, the people have spread out, in small villages, all along the lake shore. This has necessitated a considerable increase in the number of schools and stations.

Comparatively early stations were also started on the west side of the lake from Monkey Bay southwards. It was much harder for the Mission to get a footing on the southern portion of the Eastern shore of the lake, owing to the slave trade from Kota to Mluluka and other parts, and owing to fighting between the British Central African Government and Makanjila of Fort Maguire and other chiefs. A few scattered stations were, however, started.

The present (1904) area of work includes practically all the villages on the east shore of the lake from Ngofi to Losefa, and on the west side from Nkudzi to Ulandi. North of Ngofi, a new station has been started at Likumbo in German territory, and south of Losefa, are four scattered stations, two in Yao, and two in Nyasa villages.

PHYSICAL CHARACTERISTICS OF THE LAKESIDE VILLAGES.

From Ngofi to Losefa and Nkudzi to Ulandi, i.e. over the main area of work, the general physical features are similar.

The villages are built on the lake shore, generally close to a river (or, at any rate, a stream which runs during the wet season), so that the people can obtain a good supply of fish.

Behind the village is a flat plain varying from one to four miles wide. Behind this, again, the wooded hills rise rapidly to a plateau 1,200 to 1,500 feet above the lake. In few places do the hills come right down to the lake, and these spots are not generally chosen for the sites of villages.

In several places (e.g. Ngofi, Chisanga, Chia, etc.) the villages are built on a broad ridge of sand which forms the lake shore, while behind is an extensive low-lying swamp. Rice is grown in the swamp in the wet season, and, as the water diminishes, Indian corn and other crops are sown.

Of late years, in addition to spreading along the lake shore, the people have built inland, along the valleys of the larger rivers, e.g. the Lunyo near Msumba; they have also established villages on the plateau behind (a region termed "Mandu"). These are generally 1,000 to 1,500 feet above the lake, and about eight or ten miles inland. Not infrequently they are on the east side of the watershed between Lake Nyasa and the Indian Ocean (Lujenda and Rovuma rivers) for it is remarkable how very near the lake this watershed comes. At Malindi it is within eight miles, at other places it may be forty; perhaps, on an average, it is twelve to twenty miles distant. Many people who have houses on the lake shore have also gardens in the Mandu district.

Mosquito Observations.—The villages are malarious, and therefore, from the European point of view, unhealthy. They are generally close to places which breed anopheles, e.g. rice fields (as at Ngofi, Chisanga, Chia, Msumba, Losefa, Lukuloma, etc.) while in almost every case the point at which a river or stream flows into the lake is an anopheles breeding-ground (see p. 25 ff., observations on the streams at Likoma).

Moreover, the Mission station is always right in the middle of the native villages, so that there is plenty of opportunity for the anopheles which are present to acquire malarial infection.

The prevalence of mosquitoes varies considerably in different villages at different times of the year, but the variation is greater in the culices than in

the anopheles. The variation is similar to that recorded in the case of other stations.

No village is non-malarial.

As a general rule, mosquitoes do not come on board the steamer when she is lying at anchor off a village. They used to reach the *Charles Janson* sometimes as she anchored near in; especially was this the case at Kota, and in the river at Mponda's of course they came on board. The *Chauncy Maples* generally anchors too far out for them to reach her. Sometimes however, they reach her by being brought in the boats. This seems to occur most at Likoma and Malindi, possibly because at these places the boats ply to and fro more frequently in the evenings than elsewhere.

Mission History.—At first the *Charles Janson* was under the charge of the Rev. G. H. Swinny, but in November, 1886, the Rev. W. P. Johnson returned and took charge. He remained till June, 1897, when he went on furlough to appeal for the new steamer. During most of this period, he was the only priest on board; but from October, 1893, to February, 1895, the Rev. A. G. B. Glossop helped him, and from time to time there were others. From July 1896, onwards the Rev. C. B. Eyre was on the steamer. There were generally also two laymen (a captain and an engineer), though after Mr. Eyre's arrival he was captain, and there was only one layman, an engineer.

From May, 1895, to April, 1896, the steamer was hauled up on the beach at Likoma for repairs.

The Rev. J. S. Wimbush took charge during Archdeacon Johnson's furlough. The latter returned in December, 1898, and again took charge.

In July 1899, the steamer was put on the slip at Malindi, and almost rebuilt, having new bottom plates put on, and also new engines and boiler. She was launched again in September, 1900. During the first six months of this period, the Archdeacon and Mr. Barnes travelled by land among the lakeside villages, while Mr. Eyre visited all the stations up and down the lake, travelling by boat. The constant land travelling was found to involve too much strain, and was relinquished in January, 1900, and Mr. Eyre was left in sole charge.

In September, 1900, the steamer began running again with Mr. Eyre in charge, and continued till March, 1902, when the *Chauncy Maples* took her place as the steamer for visiting the lakeside stations.

After March, 1902, the *Charles Janson* became the dispatch boat of the diocese, and was stationed at Likoma. Her European staff consisted of one or two laymen. They lived on board, but spent a good deal of their time at Likoma.

The "Chauncy Maples."—As the work increased, the *Charles Janson*, which had very little accommodation for Europeans or natives, became too

small. A larger steamer was appealed for. It was sent out in 1900, and began work in March 1902. This steamer, called the *Chauncy Maples*, succeeded to the work of the *Charles Janson*, visiting the thirty-four lakeside villages where there are schools. It was also designed to be a floating Theological College for training readers and helping on teachers. Its accommodation for both Europeans and natives is excellent. There is moreover a sick bay, with hospital and nursing appliances, which can be used for special cases of illness, or for any visitor from another station who wishes to rest and recruit on the steamer. The method of work is the same as before. The staff has increased to three clergy and two laymen, i.e. captain and an engineer.

During 1902–3, the Archdeacon was in charge and also superintended the students; the Revs. C. B. Eyre and R. H. Marsh spent a good deal of their time visiting in the villages.

In 1903, work was extended further north than it had been before, as far as Likumbo, a village in German territory.

The Method of Work.—At each village where there is a Mission station is a native teacher (or reader or deacon) in charge of a native-built reed church and school, etc. The steamer is used to convey the clergy from one village to another, and to carry all the stores, etc., i.e. it is a movable Head Quarters. Often the clergy sleep on shore, or, perhaps, they stop on shore for a week or so, and are then picked up again by the steamer. The laymen, for the most part, remain on the steamer.

Until 1899 there was no house accommodation for the clergy, who used to sleep in the native schools.

Since then, European houses have been built, but they are only native-built reed huts without doors or windows.

"CHARLES JANSON." HEALTH RECORD 1886–1901.

There are several difficulties in the way of summarizing the health record of workers on the steamer. In the first place records are very scanty or absent, so that there is little definite information to go upon. Secondly, it is difficult to obtain a true estimate of the healthiness of life on the steamer dissociated from the undoubted unhealthiness of life in the lakeside villages, as so many workers on the steamer either occasionally or frequently slept ashore, or, at any rate, went ashore in the evenings. Thirdly, in the case of several of the engineers, it was the custom to spend six months on the steamer, and then six months at Likoma, and so, in some cases, it is difficult to distinguish between the steamer and the Likoma records.

Lastly, the number of workers is small, and hence deductions from statistics are particularly liable to be fallacious.

Making allowances, however, it would appear that steamer life is healthy and its record compares very favourably with that of Likoma. No death is recorded as due to malaria, though the cause of death in two cases is obscure. Mr. I. was invalided after eleven months, with beri-beri (?), but he had been subject to malaria. No case of blackwater fever occurred, except that of Mr. U., and in view of the fact that he had been invalided for a previous attack when working at Fort Johnston, and that this second attack occurred very soon after his return, and that he did two years' work subsequently without another attack, too much importance must not be attached to this. The period 1895-6, when the steamer was hauled up on the lake shore at Likoma for repairs, was a trying time for the engineers, and a good deal of illness was present, but this should be put down to Likoma.

The experience of the officers of other steamers on the lake who generally sleep aboard is also in favour of the healthiness of steamer life. The explanation is easy, for it is more bracing, particularly since there is a general absence of mosquitoes.

As regards the clergy who partly lived a "steamer life," but who also worked largely on land, the total numbers are very small, and also in almost every case they were old members, who were more or less acclimatized. The health record is fairly good, but had there been a number of new members among the workers, it would probably have been very different. There is no doubt about the unhealthiness of the villages, and more particularly about sleeping in what is practically a native hut right in the centre of the village. The trips on the steamer probably serve to brace up the clergy,and so give them better health than if they worked entirely on land. The health record of the clergy, when the steamer has been laid up and they have had to work on land altogether, is decidedly worse than when she has been running. This is easily accounted for, since not only is the bracing effect of trips on the steamer lacking, but there is also the constant worry of land journeys, and the uncertainty about the supply of stores ; in short there is an absence of any home or headquarters.

"CHAUNCY MAPLES." HEALTH RECORD.

The health record for the first two years of the *Chauncy Maples* is good, and certainly shows an improvement on that of the *Charles Janson*. Owing to the better accommodation and to the provision of a sick bay, cases of fever have been nursed, where in old days they were ignored. The severer cases are generally put off at one of the European stations where there is a nurse and a hospital.

The medical records are much more complete than in former years, and it is possible to obtain more reliable statistics. These tend to confirm the opinion expressed above as to the healthiness of "steamer life,"

The only worker who had bad health was Mr. V., and this was due to persistent disregard of all laws of health and of all mosquito precautions when sleeping ashore. Mr. W. suffered from an attack of dysentery and Miss S. from an attack of dysenteric diarrhoea. Possibly these were due to drinking infected water (see later—Precautions *re* water supply).

SUMMARY.

Total number of workers, 17. *Cases of blackwater fever*, 1 (not fatal).
Total number of deaths, 2. *Invalided*, 2 (both forbidden to return).

CONCLUSIONS AND RECOMMENDATIONS.

As stated above, anopheles, possibly infected, are generally present in the lakeside villages. Mosquitoes rarely come on the steamer, especially on the *Chauncy Maples*, which anchors further out than the *Charles Janson*. Sometimes, however, they come off in the boats. They have been noticed mainly at Malindi, Kota, and Likoma. They do not generally stay many days, and they seldom reach the cabins down below.

1. *Mosquito nets should always be used* (they are provided, but at present not generally used), at any rate *when mosquitoes are present on board*, if not at other times. It is, however, very difficult to use a mosquito net really satisfactorily in a narrow steamer berth.

2. The malarious character of the lakeside should be borne in mind, and, so far as is practicable, waiting about on the lake shore should be avoided.

Those who have to sleep ashore should be most careful to have a good mosquito net and to use it intelligently.

3. *Water supply.*—It has always been the custom on the steamers not to boil drinking water, but to draw water from the lake in deep water while the steamer is running. Probably such water is always safe. On a Sunday, or whenever the steamer is at anchor, the water round the ship gets very foul, and when at anchor the rule is that some one goes out in a boat and draws water *at a distance from the ship*. Unfortunately, there is some danger that such a rule may be overlooked and infected water be taken close by the ship.

One case of dysentery and one of dysenteric diarrhoea have occurred, and though these may have been acquired on land, they may have been due to drinking infected water on the steamer. The only entirely safe way would be to make it a rule that *all drinking water wherever drawn should be boiled before use.*

MEDICAL NOTES ON THE STEAMER METHOD OF WORK.

This method is peculiar to the U.M.C.A., so it may be instructive to inquire into the pros and cons from a medical standpoint. Originally it was adopted for three reasons :—

1. The lake shore was dangerous, because of the raids of the Magwangwara, Yaos, and Swahili traders.

2. A rule was laid down by Bishop Smythies, to the effect that the east shore of the lake was so unhealthy that no Mission stations were to be built there.

3. There were certain purely " Mission " reasons, e.g. it was argued that it would foster a more freely native growth of the Church.

How does the question stand to-day ? The first reason no longer exists, as there is no longer danger from slave raids. The third is not a medical question, and cannot be discussed here. As regards the second reason and the dictum and rule of Bishop Smythies, the following may be stated—

The lakeside villages are malarious, some of them very malarious. In Bishop Smythies' time, it was assumed, as a matter of course, that the Mission station would be right in the middle of the native village. This would undoubtedly have been unhealthy (cf. Mponda's, and to some extent Kota Kota).

The steamer method exposes the clergy to this risk for about half their time (i.e. while they are sleeping ashore), but it supplies them with a healthy home and headquarters between whiles. Moreover the laymen live on the steamer and are free from any special risks.

The attempt to work the lakeside villages by itineration without a moving headquarters was tried in 1895–6 and in 1899–1900, when the *Charles Janson* was laid up for repairs. This method necessitates always sleeping in the lakeside villages, and hence increases the risk to health, while there is the added strain of constant land travelling, with its frequent wettings in the rainy season, uncertainty about the supply of stores, absence of any home, and, in short, return to the condition of the pioneer days. Naturally this causes a bad health record, and is not to be recommended except where unavoidable.

Now, however, since the lake shore is safe, it would be possible to establish headquarters on land, and *if the principle of isolation were employed*, i.e. if the Mission station were built half a mile from any anopheles breeding-grounds and a like distance from the native village, it should be perfectly healthy. (In Bishop Smythies' time the importance of isolation was not realized, and hence such a plan was not contemplated.) Still the risk to clergy making excursions from such a headquarters and sleeping in distant villages would be just the same as it is now, when the steamer is used

as headquarters. A difficulty in the case of such European stations on the mainland would be the provision of adequate medical and nursing attention. If a serious case occurs on the steamer, she can and does run straight to the nearest hospital, which she reaches in the day. But a station on land, even if only twenty or thirty miles from a hospital, is cut off from it, for a sick person often cannot be taken that distance by machila without great discomfort. This difficulty would therefore have to be met by providing a full staff, including a nurse, at each station. Hence is it improbable that the steamer method can ever be entirely superseded by one based on a system of European stations on the mainland; for in order to cover the same area it would mean at least three or four stations, and each would require a staff of four (i.e. two men and two ladies. It is, however, very possible that, in the future, some important mainland stations may be established to supplement the work of the steamer.

Great care should be exercised in the choice of healthy sites.

It would not be very easy to find suitable sites. The only place that suggests itself as likely between Ngofi and the College is Njafua. A good site might be obtained near Ngoo, but this is rather doubtful, as the country round is swampy in many places and mosquitoes abound. The best site, which had long ago been purchased from the natives with this end in view, has been taken by the Portuguese for their fort at Mtengula. The hill to the north of Msumba might provide a suitable site, and a careful survey would doubtless reveal others.

PART IV.

Kota Kota.

Physical Characteristics.—The town of Kota Kota is a huge straggling native village, with some 5,000 inhabitants. The huts are scattered along the lake shore, and also extend inland for about half a mile. The harbour is a big shallow lagoon, open to the north and north-east, but shut in on the south-east and south by a long sandspit. The water of the harbour is dirty, but swarms with fish. The lake shore is thickly grown with reeds which extend out into the water, and in the wet season it is very swampy. Next comes a level sandy belt, about one-third of a mile wide, containing many low-lying patches, which in the wet season are swampy and are planted with rice. Many of the houses are built on this level belt. Inland, the ground rises sharply to a height of about 100 feet, and then slopes gradually upwards for nearly a mile. Native huts are built on this rising ground, and here, too, just on the edge of the town, are the European stations, viz. two trading stores, the Mission station, and the Boma (Government station).

The Mission property is a piece of ground about 20 acres in extent, just on the brow of the hill. There are native huts on either side of and below it. It is bounded on both sides by streams, one of which flows along a very swampy valley. The soil of this ridge and of the sloping hill behind is clay or gravel, with boulders of granite projecting here and there. It holds water very much, and in the wet season all the hollows are swampy, and sub-soil water is everywhere within a few feet of the surface, so that for four months of the year any pit remains filled with water. (For plan of Mission station, see p. 53.)

The village is without any kind of sanitation. The natives use the lake shore and the beds of the streams as latrines. Everywhere in the village, between the houses, patches of Indian corn and rice are grown. Often, for a month or two at a time, the low-lying rice fields are under water. A number of small streams flow through the village. These run for six or seven months and then dry up, but water can be got by digging near their beds.

On either side of the town, for miles, towards the villages of Sani and Lozi is low-lying swamp with peaty soil, where rice is cultivated.

Behind, there are bare rolling hills about 200 feet above the lake for a couple of miles, and then there is a sudden descent to the swampy valley of the Kaombe river, where the out-stations of Kasamba, Mtuntumala, and Tievi are situated.

Rice forms the staple food of the natives; fish are always plentiful in the harbour, and in the wet season large hauls are made in the Kaombe.

The water supply of the town is bad. The lake water is dirty and soiled with sewage. Drinking water is got from the streams, or more often from water holes dug near them. Dysentery (of a mild type) is prevalent, especially from August to December, when many of the water holes are dry and water is scarce.

There are a few trees in the village, and a good number of shady trees on the Mission property. Trees would grow on the hills behind, but they are constantly being cut for firewood, so that there are only scrubby bushes. The soil is fertile, and food is generally plentiful. In the dry season good feed for cattle exists among the reeds on the lake shore. Firewood is always difficult to obtain.

The rainfall at Kota is heavier than at Likoma; it is probably about 50 inches, but it has not been exactly determined.

Kota is much exposed to gales. In the wet season these come from any quarter, but in the dry season they are mainly from the south.

Crocodiles abound in the harbour, and as there is much cover, they are a source of danger. As a result, the natives seldom bathe, and they wash very little. Hence bugs, fleas, and ticks are very prevalent. Jiggers are also present.

Mosquitoes are as bad at Kota as anywhere else on the lake—or worse, Karonga being said to be the nearest rival.

The climate is very similar to that of the College, except for the more violent winds.

About two miles away is a hot spring. The water is slightly sulphurous, especially when it first bubbles up out of the ground. On standing, a good deal of the gas goes off, and when it is cold no particular smell is noticeable. The temperature of the water is about 50° C. This spring is carefully guarded from pollution by the collector, and no one is allowed to draw water there except the employés of the Europeans. The water runs down as a hot stream to join a cold one in the valley below, and in the tepid water, at the junction of the two streams, a great deal of washing is done.

Mission History.—Up till 1892 Kota Kota was known only as a big town of about 10,000 inhabitants, ruled over by Jumbe, and as the great slave port whence dhows carried slaves across to Mluluka on their journey

to the coast. Then a treaty was made with Jumbe, and a resident European administrator was stationed there. In the middle of 1894 it was rather suddenly resolved to open a Mission station there, and the Rev. A. F. Sim, who was just out from England, was sent to occupy it. The opening of the station was a sudden determination, and the ultimate consequences to the Mission and also the question of the healthiness or otherwise of the place were not sufficiently considered. The Rev. A. F. Sim lived, at first, in an ordinary native hut. In 1895, the site of the present Mission station was bought, and a good wattle and daub house was built; also Mr. Philipps came to help. In October Mr. Sim died from exhaustion following on an attack of blackwater fever and the Rev. J. S. Wimbush succeeded him. In 1896 the Rev. W. W. Auster came, and from 1897–98 he was in charge, and Mr. H. Matthews was with him. In 1897 a church, partly brick, partly wattle and daub, was built; also another house which was intended for ladies, but in consequence of Miss Ellershaw's death at Likoma, they did not come, and it was used by Auster and Matthews. These wattle and daub European houses were of a good type, with doors and wooden shutters (but no glass), and wide verandahs, altogether much better than the old Likoma houses. A good brick schoolroom was built in 1898.

In April, 1899, ladies settled at Kota, and since then the staff has been four (two or three ladies, a priest, and sometimes a layman). A new brick ladies' house, and a dining-room, with glass windows, etc., were built during this year, and from that time forward all building has been of a permanent character. Thus there were added in 1900 a brick dormitory for the schoolboys, in 1901 a magnificent stone church, and in 1902 a European sick-room and a dispensary. Since 1900 this has been a permanent station with good buildings; it has generally been kept well staffed, and since 1899 there has always been a nurse in residence.

It may be noted in passing that, in consequence of the heavy gales, native-built houses are often blown down suddenly, and so are really unsafe.

In 1902 all the European dwelling-houses were rendered mosquito-proof by dint of gauze windows and doors.

Apart from the housing question, the general standard of living here, as elsewhere in the Mission, has gradually improved from 1896 onwards.

Until 1896, water from the village water holes, or from a similar hole dug by Mr. Sim on the Mission property, was used. This, like all the village water, was bad. From 1897 onwards, water for drinking purposes has been brought from the hot springs, but, until 1900, water for washing was still obtained locally. From 1900 onwards all water for drinking, kitchen purposes, Europeans' baths, etc., has been brought direct from the hot springs. It is used unfiltered, as it is naturally sterilized. *It is of great importance that this general use of hot spring water should be continued.*

SUMMARY OF STATISTICS, 1894-1898.

Total number of workers,	6.	All, except one, were new to the country.
Total number invalided,	1.	Would have been allowed to return, but withdrew for home reasons.
Total number of deaths,	2.	
Haemoglobinuria or black-water fever.	2 cases, both fatal.	

1899-1903.—During this period there was an adequate staff of four or five persons, and a nurse was always resident. The general standard of comfort as to food, housing, etc., was as good as, or better than, at any other station in the Mission. There was, however, only one priest, and stress and worry fell heavily on him, and his health suffered in consequence. On the whole the health record was remarkably good. No one was invalided, and there were no cases of blackwater fever.

Mr. X. died from hyperpyrexia within a few weeks of arrival. This must be regarded as an accident of African life, and not as in any way specially attributable to the locality. One other member had indifferent health during 1901, but this was mainly due to the fact that he had outstayed his time and was overdone, but could not go home for furlough sooner as there was no one to take his place.

The most important improvement in the buildings, from a health point of view, was the provision of a special sick-room, and the mosquito proofing of all the European houses in 1902.

This good health record is difficult to explain, for on *à priori* grounds Kota Kota would be put down as a very unhealthy place. It may be partly chance, for during this period two cases of blackwater fever occurred among the other European residents, who together number about as many as the members of the Mission. But this is not a complete explanation, and the fact remains that between 1899 and 1903 Kota has proved a far healthier station than could have been expected. A possible explanation may be that mosquitoes (the majority of which are culices) are so abundant and such a nuisance, that persons are driven for comfort's sake to adopt those precautions which they are too apt to relax when mosquitoes are few in number.

Mosquito Observations.—Kota Kota has the reputation of being the worst place on the lake for mosquitoes. This is probably true of the lake shore and the lower parts of the town among the rice fields. On the ridge, however, where the Mission is built, at the upper edge of the town, they are bad, but probably not worse than at many of the villages between Ngofi and Msumba visited by the *Chauncy Maples.*

The mosquitoes begin with the rainy season in December or January, and continue very numerous till May. During June and July they begin to diminish, partly owing to the cold weather, but mainly to the drying

up of swamps and also of all pots and old tins which in the wet season are kept full of rain water. In August the weather gets warmer, but they do not increase again, as the swamps are drying up. Indeed, in a dry year, they dry up altogether during this month, and mosquitoes practically disappear, but in a wet year they continue for a month or two more. October and November are always practically free from mosquitoes.

On the Mission Station the mosquitoes that frequent European houses are almost entirely culices. They are an intolerable nuisance in the evening, and they will bite freely in the daytime. Certainly well over 90 per cent. of the mosquitoes which one kills in the evenings are culices. Anopheles are present at nights, but they seem to enter houses only after lights are out and all is quiet (cf. Reports of the Liverpool School of Tropical Medicine Expeditions to West Africa). This is an important point to remember in considering preventive measures.

Culex breeding-places are present everywhere in the native village and around houses (in pots, pans, etc.), but they can also breed anywhere in the ponds and swamps that abound, and at the edge of the lake, where, owing to the extensive growth of reeds, the larvae get shelter from young fish.

Anopheles breed at the sides of the streams and in the water holes, and in the swampy ground and rice fields and at the edge of the lake, as shown by Dr. Daniels. In the dry season the swamps and rice fields and many of the streams dry up, and the water holes may become too stagnant, but the edge of the lake remains as a permanent breeding-place all the year round. Of course, this is some distance from the Mission, and probably no anopheles reach it from this source, but the lake shore is a constant source of danger, and, frequently, of malarial infection to persons going to and from the steamers at night.

The main anopheles breeding-grounds in the immediate vicinity of the Mission are water holes dug by the villages along the two streams X and Z (see map); holes and ditches and swampy hollows in the piece of Mission ground across the road (these are only breeding-grounds during the wet season, January–April), and the streams X and Z themselves. Of these, X runs as a torrent after rain, and to some extent flushes itself out, but Z has a very poor flow and has swampy ground on either side of it. At some time a ditch has been cut and the attempt made to drain this valley, but it has been allowed to become blocked, and is now of no use.

These breeding-grounds, like the swamps elsewhere, dry up in August or September, but are re-established in December or January.

The number of residents is not sufficient for any statistics of the monthly incidence of malaria to be of value.

Conclusions and Recommendations.—The lake shore, the rice fields, and swamps and the village water holes cannot be dealt with by the Mission,

and it is highly improbable that the Government will do anything. Hence anopheles will always be present, and owing to the situation of the Mission on the edge of the town, members of the Mission will always run the risk of becoming infected from native children. *The general aim must therefore be not so much to diminish the number of anopheles as to avoid being bitten by them.*

1. One improvement might, however, be effected, viz. attempting to drain the swamp through which the stream Z runs, and the filling up of holes and clearing of ditches on the piece of Mission property across the road (marked X on map). The stream Z should have a clean, straight channel cut and the swampy ground should be drained by ditches and made into a garden. This would effect some reduction in the anopheles' breeding-grounds in the immediate neighbourhood of the Mission. The stream and ditches would require constant attention, but, if the ground were used as a garden, this could be attained.

2. On the other hand, accepting the fact that infected anopheles will generally be present, much can be done by careful precautions against being bitten, especially at night, when anopheles are most prevalent. The rules enumerated above (see p. 9 ff.) with regard to (*a*) Mosquito nets; (*b*) Protection of the ankles; (*c*) Fumigation with pyrethrum, and the use of oil of lavender, should be carefully observed. Further—

(1) *All European houses should be mosquito-proof*, and the means of protection thus provided should be carefully and intelligently used.

(2) *Quinine should be regularly taken as a preventive by all residents* (at present gr. xv. are taken every Sunday).

(3) *As far as possible, visits to the villages and the lake shore at night should be avoided.*

(N.B.—At the present time all the recommendations included under (2) are being observed, and the improvement mentioned in (1) will, it is hoped, be undertaken this year.)

A further note on the comparative healthiness of Kota Kota:—"There are, however, some spots in the Protectorate from which fever can never be eradicated, at least, as far as we can at present see. One hot-bed of fever, viz., Kota Kota, is a large town; it is the headquarters of a wide rice-growing district, and mosquitoes swarm during the greater part of the year. Of thirty-five mosquitoes sent to Zomba from Kota Kota, twenty-four were anopheles. Unfortunately, it would be impossible to destroy the swamp there, or materially alter the conditions under which the important rice industry is carried on. To alter the housing of the native population, put them under mosquito nets, and to ensure a systematic proper regulated dosing of quinine, would also not be possible. We must, therefore, give in to the fact of this (so far) permanent focus of malarial infection in the Protectorate, and look to a reasonable segregation of Europeans to diminish the danger."

The above cutting appeared in the British Central Africa Blue Book for 1902, forming part of the Protectorate Medical Officer's report. Unfortunately it was taken up by some papers, and part of it, without its context

PLAN OF KOTA-KOTA MISSION STATION.

and without the last sentence, was quoted in *The Times*. This served to give a most gloomy prospect of life at Kota, and caused a good deal of alarm in some quarters among the friends of the Mission.

Comparing the above paragraph with this report it will be seen that, while the statements therein contained as to the prevalence of mosquitoes at Kota are substantially accurate, yet by dint of care and reasonable precautions it is possible for Europeans to live very fairly healthily there. As mentioned above, the very fact that Kota Kota has a bad name, and that mosquitoes are very troublesome, contributes to the willingness of residents to employ those precautions and so protect their health. It is often the places which seem as if they ought to be healthy, to the casual observer, that are really the most dangerous, because their apparent healthiness causes carelessness, and carelessness brings its punishment.

On one point, however (viz. as regards the relative number of anopheles and culices), this report is at total variance with the Blue Book statement. This is to be accounted for by the fact that the Blue Book statement is founded on what was practically a single observation. I have ascertained that the mosquitoes in question were caught by the Collector (Mr. A. J. Swann). He was in the habit of using a net with holes in it, and these mosquitoes were caught inside the net in the morning. In view of the well-known tendency of anopheles to hang about the house and to go to sleep close by after feeding, their preponderance under these circumstances is easily explained.

There may be some difference between the Mission and the Boma as regards the relative numbers of the two kinds, but the statement in this respect that 90 per cent. of the mosquitoes that come and annoy one in the evening are culices is undoubtedly true of the Mission station, and it has been confirmed by repeated observations over a long period of time. It is probably largely owing to this preponderance of culices that the comparatively good health record is due.

General Observations.—1. Bugs, ticks, and fleas are very prevalent, owing to the fact that the people wash so little. They are a great difficulty where a number of children sleep together, as in the Mission dormitories.

Jiggers are also bad at Kota. They have remained on here after they have disappeared from other places on the lake. The remedy for all these pests in the Mission would seem to lie in the provision of permanent brick dormitories with cement floors.

2. The garden possiblities at Kota are considerable, and should be developed. Cocoanut palms grow in the village, and some young ones are growing at the Mission. Mangoes, guavas, limes, lemons, mulberries, all do well. If the swamp is drained, a very good vegetable garden might be made there.

The grass quadrangle in the middle of the station is very satisfactory.

It looks nice and is restful to the feet. It is planted with a kind of couch grass, which grows well. Similar grass patches might be grown with advantage at Malindi, Mponda's, and the College. At the latter place one has already been planted.

The Mission has a good herd of cattle, and plenty of feed can be obtained for them.

PART V:

Mponda's.

Physical Characteristics.—The town of Mponda's is on the right bank of the river Shiré, about two miles from the lake. The Mission station is right in the village, it is surrounded on three sides by native huts, and in front is the river. Old Fort Johnston, which was abandoned on account of its unhealthiness, was on the left bank of the river, opposite. New Fort Johnston is three miles lower down the river, on the right bank.

The Mission property is a piece of land about two acres in extent. The house is situated about 100 yards from the river, but not more than twenty feet above it.

The soil is sandy for the most part, but in places, along the river bank, there is fertile black peat. In the dry season, the ground gets baked hard, but in the wet season much of it is marshy and waterlogged.

In short, Mponda's is a typical " upper river " site, with the additional disadvantage that it is right in a native village.

The river swarms with fish, and also with hippopotami and crocodiles. The river water is polluted with sewage from the town. The banks of the river are edged with coarse grass with floating roots.

The average rainfall of Fort Johnston is thirty-five inches. The wet season is from the end of November to April.

Mission History.—The station was begun by the Rev. J. G. Philipps at the end of 1896. The early buildings were reed houses of a rather poor type. In the autumn of 1897 it was made the head store of the Mission in place of Likoma, so as to be able to deal better with cargo for Kota Kota, and Mr. R. M. Vyall, the Treasurer, came to live here. At the end of 1897 Mr. Philipps went home on furlough and during 1898 the Rev. H. J. Hancock was in charge. In 1899 Hancock went to Kota Kota and Philipps again took charge and remained there till September, 1902, when he was succeeded by the Rev. A. G. de la Pryme. During 1898 a substantial brick house with iron roof, etc., was built, and during 1899 and 1900 a brick store and elaborate outhouses were added. In 1903, this house was mosquito-proofed. From November, 1900, to June, 1901, the *Chauncy Maples* was under construction at Mponda's, and Messrs. Crouch, Christie and Maclure were at work on her. They lived in reed houses run up for the purpose. After the launch of the *Chauncy Maples*, these houses were pulled down and the station returned to the usual staff of a priest and a layman.

No doctor or nurse has been resident. A doctor can be summoned from Fort Johnston. Cases of illness are either nursed at Malindi or the nurse is summoned from thence.

In addition to the work in Mponda's itself, the priest-in-charge has to minister to the Europeans in Fort Johnston, and there are out-schools at Samama at the entrance to the river and at Chileka in the hilly country behind Monkey Bay, twenty-five miles away.

HEALTH RECORD. 1896–1903.

In some ways the conditions of life at Mponda's have been exceptionally favourable. There was a very short period of pioneer work and a good house was built within two years of the station being started. Also, owing to its being situated at the source of supply, stores, etc., are easily obtained. The general standard of comfort was high. There was no regular medical attendance, but from 1899 onwards a nurse was generally stationed at Malindi. In spite of this, the health record has been bad. Two at least and possibly three attacks of blackwater fever are referable to this station ; these occurred between 1899 and 1903, during which period there were only five attacks in the whole diocese. Moreover, the health of new comers has been significantly poor, especially when compared with the recent (1899–1903) health record of Likoma, Kota Kota or Malindi.

SUMMARY OF STATISTICS. 1896 1903.

Total number of workers,	12.	
Total number invalided,	1 (or 2).	*Haemoglobinuria, blackwater fever.*
Total number of deaths,	1.	Number of cases, 2 (or 3) ; Number of deaths, 1.

Mosquito Observations.—Careful observations were made by Dr. Daniels in 1899 and 1900 at Fort Johnston and Mponda's and along the upper river. He found that anopheles were very plentiful and that their great breeding-place was among the grass along the edges of the river. Doubtless, in the wet season, additional breeding-places exist in streams and pools and swamps, but the river is the constant breeding-place.

At Mponda's infection of the anopheles readily takes place, owing to the proximity of the native village.

After examining all the Government and other records, Dr. Daniels concluded that the Upper River district from Mponda's to Matope was distinctly the unhealthiest region in B. C. A. The average period of residence prior to infection with malaria is only one month, while in many other districts it is six months to a year. As regards the prevalence of blackwater fever, his conclusion was similar. The number of cases per cent. of white population is far higher here than elsewhere in B. C. A.

These facts are readily explicable when it is realized that the river forms the main anopheles breeding-place and is thus a constant source of supply all the year round. During the dry season, culices cease to be troublesome, but a large number of anopheles is always present.

At Fort Johnston a considerable sum has been expended in clearing the river bank of grass and piling up a steep foreshore. Also the native population and soldiers have for the most part been moved to the opposite side of the river. These measures have been attended with partial success, but neither of them are practicable in the case of the single European settlement at Mponda's.

No other means for dealing with the malaria problem of the Upper river was suggested by Dr. Daniels.

Conclusions and Recommendations.—1. It must be admitted that Mponda's is situated in the unhealthiest region in B. C. A., and that little can be done to make the surroundings healthier. Moreover, the health record of the station is decidedly bad.

Hence on medical grounds it is advisable to reduce as far as possible the number of members of the Mission who reside there.

From the purely medical standpoint, the ideal would be to occupy the station with a native priest or deacon and to withdraw the European residents.

If this is impracticable, it might be possible to place there one acclimatized priest, and to move the Treasurer to Malindi.

Whether either of these plans be possible or not has to be determined on other than medical grounds.

The neighbouring station of Malindi has a remarkably good health record and it is certainly advisable that development should take place there rather than at Mponda's.

2. The other recommendation is to follow the rules already laid down in the case of Kota Kota for avoidance of mosquito bites; although, owing to the much greater prevalence of anopheles at Mponda's as compared with Kota Kota, they are less likely to be completely successful.

The Mission house has been mosquito-proofed, and this improvement should be utilized to the greatest possible extent, by staying in at night as far as practicable.

General Observations.—*Water Supply.*—The water of the river is very much inferior to that of the lake and it has abundant opportunity for sewage pollution. Dysentery is common among the natives, especially in the dry season.

Hence special care should be exercised in boiling all drinking water. No trust should be put in filters.

Malindi.

Physical Characteristics.—Malindi is only eight miles from Mponda's, but the physical conditions are totally different. It is distinctly a lake station and possesses none of the special disadvantages of the Upper Shiré region.

The station is built at a spot where the wooded hills come down very close to the lake. There is a narrow, more or less level, belt only 150 yards in width, on which the station is built, and behind it the hills rise steeply. North and south of the station, the hills recede from the lake, leaving a flat belt of fertile land a half to two miles wide. Here are native villages and gardens. Chindamba's is about one mile to the north and Makumba's three miles to the north. Between these good sized villages and the Mission, a few straggling hamlets exist, one on the south side being only 150 yards from the station.

The lake shore in front of the station is clean and sandy, but on either side it is edged with reeds. These, however, do not grow far out into the lake, as at Kota, and probably they afford no breeding-ground for mosquitoes, for the shore is swept by winds from the north, south and west. From a sanitary point of view, the disadvantage is that the natives use this reed-fringed shore as a latrine.

The lake here, at its south end, is shallow, with a sandy bottom. It swarms with fish. Crocodiles and hippopotami are plentiful. On account of this shallowness, and also because of the insanitary condition of the reed-covered shore, the water at this end is probably much less pure than the lake water generally.

The soil of the belt of land above mentioned, between the lake and the hills, is black sand, with here and there pockets of gravel or patches of rich loam. The latter is selected by the natives for growing Indian corn, while beans and cassava are planted on the sandy parts. Owing to the porous nature of the soil, there is no swamp in the neighbourhood of the Mission, even in the wet season. There are also no rivers of any size. About fifty yards to the north and 250 yards to the south, are watercourses. During rain, there are rushing torrents coming down from the hills, but they do not remain as permanent streams for any length of time after the rains are over, and for about seven months of the year they are quite dry.

The hills behind are well wooded. They rise rapidly to a height of 1,200 to 1,500 feet above the lake, to a well wooded, well watered rolling plateau 3,000 to 4,000 feet above the sea, which stretches away to Mangoche (Zarafi's hill) on the south, and Mtonya and Unangu to the north.

The watershed between the lake and the Indian Ocean comes remarkably near the former at Malindi, being not more than seven or eight miles inland in some places.

Malindi is exposed to winds; the south wind blows with great force up the Shiré valley; it is freely open to the west and north, and the hills do not shelter it from the east wind, which rushes in great gusts down the gullies, blowing from the higher land down to the lake. In the dry season, between August and October, the natives burn the grass on the hillside, and also all the corn stalks and rubbish in their gardens. The east wind, blowing over this burnt ground, causes dust storms of very fine penetrating black dust, which is extremely unpleasant, but probably not unhealthy. The scorched ground in the neighbourhood is hot and unpleasant at this time of the year, but, on the whole, the climate is pleasanter and cooler than at many places on the lake. Owing to the proximity of the wooded hills it is decidedly cooler than Mponda's.

There are no records of rainfall. It is probably higher than at Fort Johnston and Mponda's. The rains begin at the end of November, i.e. about a month earlier than at Likoma. Lions and leopards occasionally do damage in the vicinity, but they are not plentiful. All kinds of building material are plentiful, good and easily obtainable.

There is the nucleus of a good garden, and the possibility of much improving it.

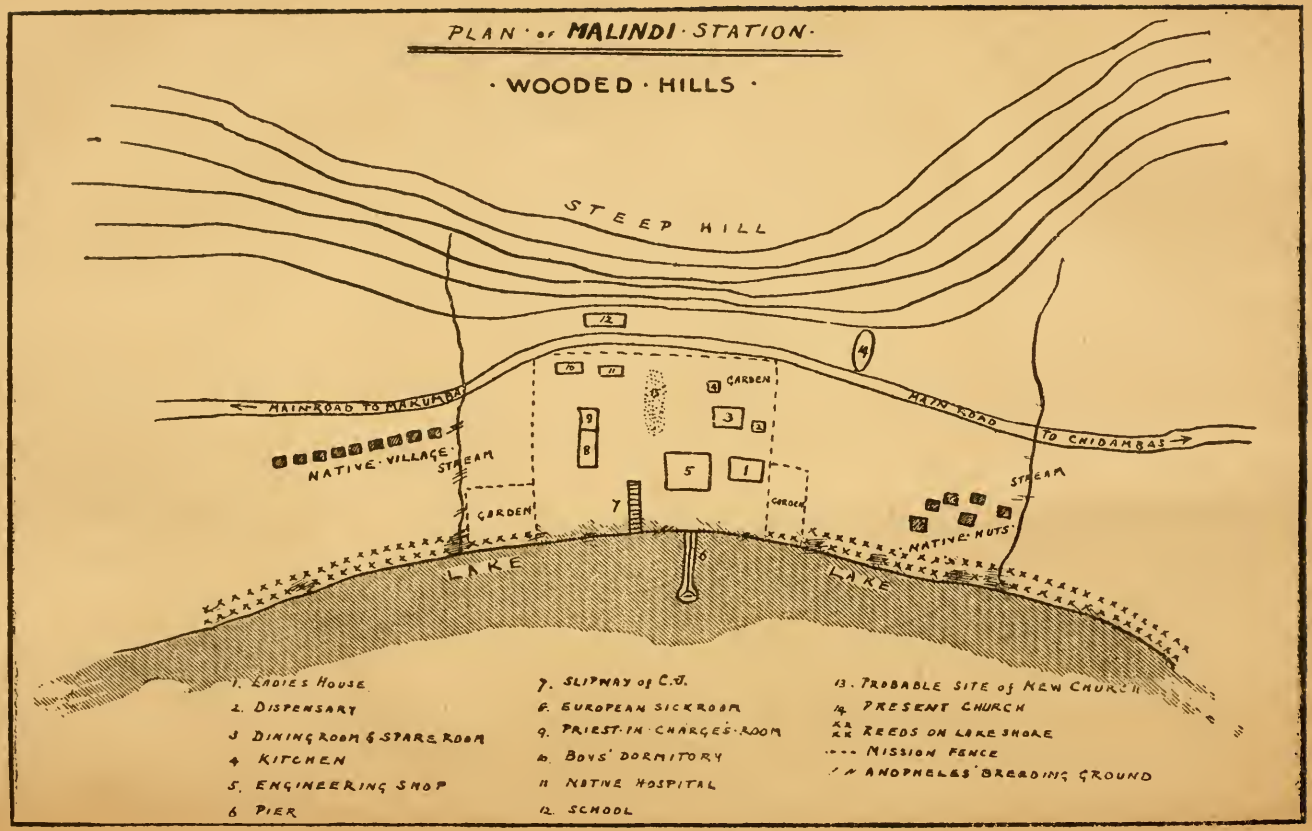
Mission History.—The station was opened by Mr. F. W. Bradshaw in 1898. It was designed as an engineering station and was begun with a view to the repair of the *Charles Janson* and the building of the *Chauncy Maples*. A rough stone house (with three rooms, glass windows, etc.) and a kitchen and store rooms were built. In 1899 the slipway for the *Charles Janson* and a large workshop with an iron roof and a store were completed. In 1899 and 1900 the *Charles Janson* was repaired.

From January to May, 1901, the station was closed, while the shell of the *Chauncy Maples* was under construction at Mponda's, but in June it was reopened and the *Chauncy Maples* was towed over to be fitted up. This was completed in March, 1903, when the station was again closed until May, being then reopened as a regular Mission station in charge of the Rev. C. Davies.

During 1898 and the first part of 1899 there were two or three engineers resident. For the rest of the time there were generally also a priest and two ladies, one of these being a nurse.

Very little outside Mission work was done, attention being confined mainly to ministering to the number of Christian workmen employed. There was only one stone dwelling-house, but the ladies had a very good wattle and daub house with doors and glass windows, quite equal to a stone house from the health standpoint. The men were housed in rather poor wattle and daub buildings, but in 1901 a good dwelling-house was made out of part of the store.

After the place was made a regular Mission station, the staff was one



PLAN OF MALINDI STATION.

priest, two ladies and a layman. A new ladies' house of brick was built in 1903, and, in the same year, an European sick-room was made out of the rest of the store. A dispensary had been built in 1902. The station consists of two parts : (1) the European part and (2) the Mission village of about ten huts, just across the watercourse to the north. Here the Christian workmen were housed during the construction of the steamers, and now the teachers, cook, watchmen and personal servants live there. The schoolboys sleep in a dormitory on the European station, and the same is true of the native patients in hospital.

Out-schools exist in the villages up to five miles distant, and in 1904 an out-station has been opened at Chi Chowis, a village near Fort Mangoche, fifteen miles from Malindi.

HEALTH RECORD. 1898–1903

In comparing the health record of Malindi with that of other stations, it must be remembered that all its history dates since 1898, and hence it is with the records of later years, and not those of the earlier pioneer days that it must be compared. There was practically nothing in the way of pioneer work at Malindi. The station was begun with a stone dwelling-house, and stores, etc., were readily available, owing to the proximity to Mponda's ; but during 1898 and 1899 there was not any medical or nursing provision. A difficulty in ascertaining the true health record of Malindi (especially during the first three years) lies in the need of distinguishing between attacks of malaria really contracted at Malindi and those contracted during visits to Mponda's and Fort Johnston. Thus it is probable that an attack of blackwater fever that occurred here is really attributable to such visits and not to Malindi.

Mr. Y. was invalided home within the year, but as an unsuitable subject for Africa. The Rev. H. J. Hancock died soon after his return from first furlough, but his death was almost certainly not the result of fever.

Making all allowances, however, the health record of the station comes out remarkably well, at least equal to, if not better than, that of Likoma in recent years. This is especially the case from 1901–1903 when the regular residents at Malindi had remarkably good health and scarcely any malaria was contracted at the station. A number of new members of the Mission stay at Malindi, while waiting for the steamer, for periods up to three weeks or a month, and during this time they are very likely to develop their first attack of malaria, which has really been acquired on the river ; also, patients are often admitted into hospital from Mponda's or from the steamer, so that the number of cases nursed in the hospital must not be taken as indicative of the health record of the station.

SUMMARY.

Total number of workers,	20.	Of these, three were acclimatized.
Total number invalided,	2.	(1 constitutionally unfitted).
Total deaths,	1.	Not due to the climate.
Haemoglobinuria, or black-water fever	1 case (?).	Not fatal. (Possibly this is referable to the upper river).

Mosquito Observations.—There are generally very few mosquitoes at Malindi, not more than there are on the Mission station at Likoma. They are, moreover, for the most part culices, and anopheles are scarce. During the dry season mosquitoes are practically absent.

As regards breeding-grounds, the lake itself does not serve as such (as it does at Kota Kota and as the river does at Mponda's) because the reed growth on the shore is not thick enough to provide shelter from the waves by which the shore is washed.

Culices doubtless breed for the most part in pots and pans about the station, and would be greatly reduced if these were systematically cleared away. They probably also breed in chance pools near the lake shore.

As regards anopheles, the observations have not been as complete as is desirable, in particular, no systematic search has been made throughout a wet season. Breeding-grounds are undoubtedly scanty, and when search has been made they have been hard to find; in the dry season they are practically absent.

In the wet season it is probable that chance pools along the lake shore, cut off from the lake itself, but with water kept fresh by rain and by soakage through the sand, form an important source. Similar pools are mentioned in the Likoma observations, and it is noted there that, though they are very favourable spots for the development of the larvae, being protected from fish and other enemies, yet they are uncertain as regards their duration and are apt to be washed away by the waves if a strong wind gets up (see p. 24).

The small mountain streams on either side of the station are flushed out during the rains, but, at the end of the wet season, they probably serve as a breeding-ground for a month or two (March or April till May or June). Probably also breeding-grounds exist during most of the wet season just at their mouths where they flow into the lake. (Cf. somewhat similar streams at the College, see p. 34.)

In short, the main anopheles breeding-ground must be the neighbourhood of the lake shore, but the conditions are not favourable, and so anopheles are scarce. This is further evidenced by the fact that, though the station is within 100 yards of the lake shore (in fact the station property goes right down to the lake), anopheles are never plentiful in the houses.

These lake shore breeding-places do not lend themselves to any radical treatment. The pools have no certain position and, as shown in the case

of Likoma and the College, it is extremely difficult to deal with the point where a stream flows out into the lake and throws up a bar at its mouth.

Hence it must be accepted that anopheles, though in small numbers, do, and will, continue to breed on the lake shore in the neighbourhood of the Mission.

Will these have ready opportunity for becoming infected with malaria ? Here the answer is in the negative. The Mission station stands comparatively alone, and it is not crowded round with native houses. On the north side there is the Mission village above mentioned about 100 yards distant, but there are no other houses for a quarter of a mile ; on the south side there is a small hamlet about 150 yards away, but no other huts nearer than a quarter of a mile.

Conclusions and Recommendations.—The above-mentioned facts lead to the conclusion that the good health record of the station and its comparative freedom from malaria are due to : (1) The small number of anopheles, owing to the natural scarcity of suitable breeding-places, (2) the improbability of such anopheles as exist becoming infected, owing to the small number of native huts in the vicinity of the mission.

As stated above, it is not feasible to attempt to still further reduce the number of anopheles, and hence attention must be directed to the second point, viz., *maintaining the principle of segregation*, i.e. separating the European station by a distance from native huts. Segregation of Europeans has been advocated largely on the West Coast of Africa ; if it were complete, the anopheles would have practically no chance of becoming infected and would be innocuous. On a mission station, segregation cannot be complete ; schoolboys, hospital patients, and some retainers will always have to sleep in the neighbourhood of the Mission station, but a certain degree of segregation can often be obtained and, as pointed out, does actually exist at Malindi. With a view to maintaining or increasing this segregation, the following recommendations should be observed :—

1. No new native huts should be built within at least a quarter of a mile north or south of the station boundaries, and if possible the existing ones should be bought up and removed. This can probably be easily attained by a friendly arrangement and with compensation to the chiefs. On the other hand, if it is not kept in view, there is a real danger that the Mission station might soon be quite surrounded by native huts.

2. The number of families living in the Mission village should be reduced to the minimum demanded by the needs of Mission work. The houses should be few but good. All old disused houses likely to harbour mosquitoes should be destroyed. By rebuilding houses as required at a slightly greater distance from the station, the village might be moved 100 yards further away, which would be an advantage.

3. Should the opportunity of buying or renting the land north or south

occur, it would be very advisable to do so. A quarter of a mile on either side clear of native huts would do more than anything else to ensure the healthiness of what promises to be an important station.

In the case of the European sick-room, the further precaution of rendering it mosquito-proof is being taken. It is hardly feasible to adopt a general system of mosquito-proof houses as has been done at Kota and Mponda's. It would be expensive and, in view of the slight annoyance caused by mosquitoes, it would be difficult to get residents to comply with rules as to shutting windows, doors, etc., without which the means of protection provided would be of no avail.

General Observations.—1. From the sanitary point of view, to prevent a nuisance in the neighbourhood, and also to reduce the pollution of the lake water, all the reeds and acacia trees growing on the lake shore in the immediate neighbourhood of the Mission property should be kept cut.

2. In view of the remarks made above about the indifferent character of the lake water at the south end of the lake, special care should be taken that all drinking water is boiled.

3. A fly with an anthropophagous larva is fairly common at Malindi during the first half of the year. Few residents escape without a crop of boils due to these larvae each year. This is the only station of the Mission at which this fly is common. It exists at Chisumulu, and maggots in dogs due to the same or an allied species have been seen at Kota Kota, Likoma and the College, though cases in Europeans have not occurred at the above-mentioned stations during the last few years. The fly is believed to lay its eggs on the clothes when hung up to dry. The boils are usually about the waist or buttocks, but they may occur anywhere on the body. A bread poultice seems to be the most effective means of extracting the maggot, when it is big, but if recognized when it is quite small, lying in the centre of a small irritable papule, it can with skill be extracted with a needle.

PART VI.

Unangu.

Physical Characteristics.—Unangu is sixty miles from the lake, almost due east of Mluluka (see map, p. 38). The town is at the foot of a mountain which rises 2,000 feet or more out of an extensive plain 1,800 feet above the lake (3,300 feet above the sea). It is in the watershed of the Lujenda river, which joins the Rovuma and runs into the Indian Ocean. The natives, who are Yaos, are naturally forest-dwellers, living in clearings in the wooded country and cultivating large fields. They fled for safety to Unangu to escape from the Magwangwara, and built their villages on the sides of the mountain, while they had their gardens in the plain. As a result, this plain, doubtless once covered with trees, has been converted into a bare, treeless expanse, extending for five miles all round the mountain. Beyond this are wooded hills and plains. At one time the population living at Unangu was over 5,000.

The Mission station is just at the foot of the mountain. In 1893, when the site was bought, all the houses were on the side of the mountain above it. Of late years, however, as the fear of the Magwangwara has vanished, very few huts remain on the mountain. More than half the people have moved out into clearings in the forest, 10–20 miles distant. The rest are living in huts on the same level as the Mission, at the foot of the mountain. Probably, before very long, nearly all the people will move away, their reason being the wish to have firewood close at hand and to get virgin soil for their gardens. Already a good deal of the plain is left uncultivated. The soil is naturally fertile, but it has become rather exhausted.

The water supply consists of streams coming down from the mountain. These have bananas and much rank grass growing along their course, where the natives make their latrines, so that the naturally pure water becomes polluted.

The mountain itself is of granite; the soil of the plain is clayey, with patches of gravel, on one of which the Mission station is built. Along the courses of the streams is a good deal of swampy ground, and in some places there are regular peaty swamps.

In May, after the wet season is over, the ground is a good deal water-logged, and, in any depressions, there are marshy patches. Even in September, the subsoil water is within six or eight feet of the surface.

The climate is much cooler than on the lake level. In May and June the sun rises behind the mountain, so that the station is in shade till 8 o'clock in the morning; there is a heavy dew, and it is unpleasantly cold. From May to July there are cold south winds. Later in the year, sudden gusts of wind, like small whirlwinds, rush down from the mountain, causing "dust devils." From September to October the whole of the plain is bare, and the natives burn the grass, and millet stalks, and rubbish all over it. This hot, scorched, treeless expanse is most unpleasant, and five miles of it must be crossed before the pleasant forest country is reached. There are no shady walks anywhere in the neighbourhood of the Mission station.

The food of the natives consists of millet and Indian corn, together with beans and peas. Sometimes they kill game, which is plentiful in the forest.

A good European garden could be made near the Mission, as the ground is fertile; there is plenty of water and the climate is cool. The greatest disadvantage of the place is the treeless plain surrounding it, which means that all firewood, timber, etc., for building has to be brought at least five miles. Stone, suitable for building, can be obtained near at hand.

Mission History.—The station was opened by Dr. Hine in September, 1893. He and his companions during this period lived in wattle and daub houses. After Dr. Hine was invalided, Padre Yohanna was left in charge, and he has remained so ever since, and the station has not been again permanently occupied by Europeans. In 1898 Mr. H. Williams went up to build a church and stone dwelling-house. He built the latter, but after three months he died, and the church was left unfinished. In 1900 Mr. F. George and Mr. J. P. Clarke were at Unangu from May to November, and built a fine stone church. They also put glass windows in the dwelling-house.

The present buildings consist of a stone church and dwelling-house; all the school buildings and Padre Yohanna's house are wattle and daub.

In 1895 a well was dug, intended for supplying drinking water. It was only a surface well 15 feet deep, and no adequate protection against surface pollution was made. Now it is only used for washing clothes, etc. *It should never be used for drinking purposes.*

As mentioned above, the drinking water of the streams is liable to pollution. As the people go away, however, the sources of pollution will be removed, and in a few years there may be pure water coming down from the mountain side.

HEALTH RECORD. 1893–1900.

This has not been good. Doubtless the climate is more bracing than at the lake, but all residents have suffered a good deal from malaria, and two deaths are referable to this station, viz. that of Mr. A. A., who was invalided and died on his way home from blackwater fever; and that of Mr. B. B., who died comatose, with somewhat obscure symptoms (blackwater fever ?).

SUMMARY OF STATISTICS. 1893–1900.

Total workers, 7. *Invalided*, 1. (Not due to climate and allowed to return.)
Deaths, 2. *Blackwater Fever*, 1. (or 2 ?). Both fatal.

Mosquito Observations.—No complete observations have been made. During the wet season, and for three months afterwards, anopheles' breeding-grounds are abundant in the streams and swampy ground near. During the last two months of this period (June and July) their number is kept in check by the cold weather, which retards their development. In the latter part of the dry season few breeding-places exist, and mosquitoes of all kinds are scanty. Owing to the proximity of native huts to the Mission station there is plenty of opportunity for anopheles to become infected.

Thus the unfavourable conditions are (1) abundant anopheles breeding-grounds near the Mission, and (2) the presence of native huts close by; the only favourable condition being the cool climate which checks the development of mosquitoes, and so reduces their numbers.

Recommendations.—Unangu has not proved healthy. This is easily accounted for by the unfavourable site of the Mission station as regards anopheles. Further natural disadvantages are the bad water, the difficulty of getting firewood, the cold damp mornings in May and June, the treeless plain which is scorched up in the summer, and the absence of any shady walks in the neighbourhood of the Mission. For these reasons it is never likely to be the health resort that was at one time hoped; also the distance from the lake (three days' journey) makes this out of the question.

On medical grounds it cannot be considered advisable that the station should again be occupied by Europeans, but should Mission considerations require its occupation, it could be made healthier by building mosquito-proof houses, and very probably by the use of other precautions.

Also, as the people move away, the sources of pollution of the water and of infection of mosquitoes will be decreased.

General Observations.—Jiggers have been very bad at Unangu. When they first appeared about 1893 many people lost toes from the sores they caused. They have remained on here while they have disappeared elsewhere, as was noted in the case of Kota, and they still cause much trouble. The reason is probably the same as that given for Kota, viz. the fact that the people bathe and wash so little. The reason at Unangu being that there is no lake to bathe in.

PART VII.

General Review of the Health of Missionaries, 1885-1903.

Taking the statistics of all the workers at Nyasa and reviewing them as a whole, the conclusions formed are very similar to those already enumerated in the case of the most important station, viz. Likoma, but, if anything, the improvement in health during recent years is even more marked. During the earlier period of Mission work, i.e. up till 1891, there was very fair health, in spite of the pioneer work that was being done, but this must be accounted for mainly by the fact that the number of workers was small (about twelve), and many of these had been acclimatized by residence in the Zanzibar diocese.

The years from 1892 to 1898 were a remarkably bad period. During these seven years there occurred twelve deaths, fourteen were invalided, and there were sixteen attacks of blackwater fever ; in each case these figures represent about two-thirds of the total number for the whole nineteen years from 1885 to 1903. This period of disaster was not due to the opening of specially unhealthy stations, but rather to the fact that there was a large increase in the number of workers, and the new members were all quite unacclimatized. Also, several of those invalided were constitutionally unfitted, and should never have been allowed to come out. Naturally the losses of this period caused great uneasiness at home. The Medical Board was constituted in 1894, and at once began a system of careful examination of all intending candidates, and advised that better dwelling-houses should be built. Moreover, the whole tide of opinion in England turned against the idea of attempting to live a rigorously ascetic life, and condemned foolhardiness and lack of precautions.

These ideas only gradually gained ground in the Mission, and their effect was probably not really felt till 1899.

From 1899 onwards it may be said that the old ascetic ideal had been definitely abandoned, and that a real attempt was being made to co-operate with the Medical Board and to recognize the need of precautions and obey the laws of hygiene. Moreover, in 1899, " the two years' rule " of the Medical Board first came into operation, and better medical and

nursing attention was provided, with the result that patients were willing to nurse their fevers instead of neglecting them, and trying to "shake them off." Gradually, too, the old idea that it was necessary to have malaria was abandoned, and the fact that it is a preventable disease began to be recognized. The improvement in health dating from this year is very striking. During 1899 and 1900 this improvement was not so marked for the whole diocese as it was in the case of Likoma; this was due to the fact that two, if not three, cases of blackwater fever (referable to the most unhealthy station, viz. Mponda's) occurred. Between 1901 and 1903, in addition to the above, there was also the general recognition of the "mosquito theory" of malaria, and the attempt to follow out the indications and precautions suggested by it.

The health record during these three years is quite phenomenal; no one was invalided, and only one attack of blackwater fever occurred, and this in spite of the fact that the staff had greatly increased in numbers and averaged thirty-five. It is very tempting to attribute this special improvement to the application of the mosquito malarial theory, but it is to be feared that the record of these years must be regarded as exceptionally good and not likely to be maintained at the same level; in part, at any rate, it is probably due to the fact that the period was one of very low rainfall, which caused a general diminution of anopheles breeding-grounds; in part, too, it is probably due to accident. But, making all allowances, it is very encouraging, and it suggests that the limit of steady improvement has not been reached.

A Note on Healthy and Unhealthy Parts of the Year.—Bishop Maples used strongly to maintain that the second quarter of the year was much the unhealthiest.

The monthly incidence of malaria is worked out for the last five years at Likoma (see p. 22); for other stations the statistics are too few, or the information at hand too scanty to allow of any reliable conclusions.

In the case of Likoma it was seen that the second quarter was distinctly the most malarial, while the last quarter was the most healthy.

Working out a similar return for the incidence of blackwater fever there is seen to be no season when attacks are specially liable to occur. The number of attacks that have occurred during the first three quarters are practically equal. The last quarter, however, has only half the number of attacks referable to it. In the case of deaths the result is just the same. The first three quarters of the year have claimed an equal number of victims, but only half this number is referable to the last quarter.

Hence, it would appear that, while no period of the year is to be dreaded as specially unhealthy, the last quarter is undoubtedly that which is freest from serious or fatal illness, although it is the hottest and, physically, the least pleasant and most exhausting time of the year.

PART VIII.

Critique of the Applicability to the Mission Stations of the various Methods of Protection against Mosquitoes.

In the foregoing pages recommendations have been made in the case of each station with a view to securing the best protection that seems feasible against the bites of infected anopheles. It is necessary now to summarize these suggestions, and to see how far they accord with generally accepted principles, and further to see what fuller application of these principles might be made in the case of a new station, planned out on health lines *ab initio*.

Three main methods have been propounded. Each of these, if it could be carried out ideally, would be effective in exterminating malaria. Unfortunately, no method can be carried out in its entirety, so that it is necessary to look to a combination of methods to achieve the best result that is practicable. The methods are—

1. Destruction of anopheles by removing their breeding-grounds.
2. Destruction of malarial parasites in natives by compulsory administration of quinine.
3. Prevention of the bites of infected anopheles.

The second method (Koch's) is not feasible. The Mission has no powers of compulsion. Further, in view of the smallness of the white population and their scattered condition, it is not a method that is ever likely to be employed by the Government of British Central Africa.

The first method, also, has only a limited application. It has been advocated as a subsidiary measure at Likoma and at Kota Kota. Owing to the nature of the breeding-grounds and their extent, and also owing to the enormous cost of materials for culverts and gutters (cement, iron pipes, etc.), radical measures of extermination would not be feasible at any of our stations. Dr. Daniels pointed out that this method would be enormously costly, even at a place like Blantyre, where there is a considerable white population, and he did not think that it would ever be systematically employed in British Central Africa.

It is to the third method, viz. the prevention of the bites of infected anopheles that most attention must be directed, as this can be applied in different ways to all our stations. There are two main means by which this prevention of the bites of anopheles may be achieved—

1. By *personal* precautions, mainly those of mechanical protection.

2. By *general* precautions as to the site of the Mission station.

1. *Personal precautions* against mosquitoes have already been discussed (see p. 9 ff.) : they consist in—

(*a*) The use of mosquito nets.

(*b*) Protection of the ankles.

(*c*) Fumigation with pyrethrum, and the use of oil of lavender.

To these may be added—

(*d*) Living in mosquito-proof houses.

(*e*) Taking quinine regularly as a preventive of malaria.

(*a*) is the rule at all stations of the Mission. The other special precautions are advocated mainly at Kota Kota and Mponda's, where, owing to the great prevalence of mosquitoes, they are specially needed. Of course (*d*), if it could be carried out in its entirety, would be effectual without anything else. It is the method that finds most favour in Italy.

In a tropical country, however, it is more difficult to use satisfactorily, and it is expensive. Windows have to be larger than in Europe. Also it is hard to get skilled workmen to make a good fit. White ants destroy woodwork, and all woodwork is liable to warp in the wet season. Moreover, it is not possible for missionaries to remain inside a mosquito-proof house and avoid all going out after sunset, especially as the dining-room is generally a separate building, and native servants do not sleep in the house.

In spite of these drawbacks, the method has been employed with considerable success at both Kota and Mponda's, and it is hoped to extend it to some of the buildings at Malindi, the College, and Likoma

The routine administration of quinine as a preventive (*e*) is also advocated at Kota and Mponda's. Although it does not prevent bites of infected mosquitoes, it aims at neutralizing their effect, and so may reasonably be included here.

2. *General precautions* as to the site of the Mission station may aim at—

(*a*) *Isolation* from anopheles by distance, i.e. building the station at a distance from anopheles' breeding-grounds beyond their usual power of flight, e.g. one-third to half a mile.

(*b*) *Segregation* of Europeans from natives, by placing the station at a similar distance of one-third to half a mile from native villages. In this case, even though anopheles exist, they will not be infected with malaria and will be harmless.

These two methods have already been referred to more than once in the

accounts of the separate stations. Unfortunately their complete application to a Mission station is difficult, and in the case of a station already established, it may be impossible; though in many cases a good deal may be done by attention to these principles.

(*a*) *Isolation from Anopheles.*—The possibility of this will, of course, depend on the extent and nature of the breeding-grounds, and this again depends on the physical characteristics of the locality. At many stations on the lake, however, the neighbourhood of the lake shore is the great anopheles breeding-ground, and, by removal to some distance from the lake, isolation may be obtained. As already shown in the case of the Mission station at Likoma (Chipyela), isolation to an extent of a quarter to one-third of a mile has been obtained. It is true that this is due rather to accident than design, but its effect has been markedly beneficial. Had the station been built originally a quarter of a mile further from the lake, it would have been probably free from malaria altogether. Of course, it is not possible to move a whole station where it has been permanently settled, but it must be remembered that every 100 yards tending towards isolation is an advantage. Where some degree of isolation already exists it must be maintained by preventing the building of native huts in the intervening space, and, if possible, it must be improved by removing such huts as exist there. Extensions of the stations can always be made further away from the source of anopheles, on a healthier and more isolated site, as suggested at Likoma and at the College.

The obvious disadvantages of isolation are: (1) it generally means building the station at some distance from its water supply, and (2) since native huts are generally built close to the lake or to streams, it often means separation from native villages.

(1) The disadvantage of being some little distance from water is more apparent than real. It makes little difference whether water has to be carried 100 yards or half a mile, it only means employing a few more women water carriers. At Kota, the station is over half a mile from the lake and two miles from the drinking water supply, but these facts do not cause inconvenience.

(2) The separation of the Mission station by a short distance from the native village may have certain disadvantages from the Mission standpoint. In the early days of the Mission it was thought necessary to live right among the people. Now, however, ideas have changed a good deal, and some degree of isolation from the village with its beer and dancing, and heathen life, is an advantage, even from the Mission point of view, and would probably now be advocated by most Missionaries; while from the sanitary and hygienic standpoint it is an unmixed benefit.

(*b*) *Segregation of Europeans from natives* is the method which has been strongly advocated by Stephens and Christopher (Malarial Commission

Reports), and has been put into practice to some extent on the West Coast. It is also the practice in India on hygienic grounds. It is one of the most certain methods, as well as the simplest, and least expensive, and beyond the primary trouble of securing a suitable site and preventing the encroachment of native dwellings, it involves no inconvenience to the Europeans.

On the other hand, it is obviously not suited in its concrete form to a Mission station. The object of the Mission is to be in touch with and train natives. Hence, schoolboys and girls who are under instruction must sleep on the Mission station, to keep them away from the temptations of village life. Also, the hospital patients must be under the eye of the doctor or nurse. But here the necessity ends. There is no need for married Christians to live on the station; indeed, the policy of the Mission maintains that it is better for them to live in the villages and try and raise the tone of village life. If married natives do not live on the station there will be no children under the age of ten years. As seen above, it is children under ten, or, even more, under five, who are the great sources of malarial infection, and if these are not allowed to sleep on the station a good deal of the benefit of segregation will be attained. Of course it is true that every native tends to attract mosquitoes, for, as he sleeps unprotected, the mosquitoes can always get a good meal off him; but this cannot be helped, or rather it can only be met by placing the station at a distance beyond their powers of flight, i.e. by the first method of isolation. Although, as a general principle, married Christians live away, in the village, yet in certain cases (e.g. teachers, etc.) it may be necessary for them to live on the station, so that the method of segregation cannot always be carried out even as regards the children under ten. What is needed is the general recognition of the fact that every native family on a Mission station is a menace to health, and that the number should be reduced to the minimum required for Mission work. Even though it may not be possible for teachers to live right away from the station, their houses may often be built, as at Malindi, 100 to 200 yards away; and if precaution is taken to place the houses in a direction remote from anopheles' breeding grounds, every 100 yards of segregation thus obtained is an advantage.

The station where segregation is a *main factor in health, and where it must be maintained for the future* is Malindi.

In the Case of a New Station, it is of greatest importance that these two principles should be kept in mind when the site is first chosen, and building commenced. The whole station should be mapped out, and the lines laid down adhered to, particularly as regards the site of native dwellings. A few huts thoughtlessly allowed to grow up in a bad situation may be a source of chronic malaria, and determine a bad health record for a whole station.

Of the two principles, isolation is the most suited to a Mission station, though, as far as practicable, segregation should always be employed as well.

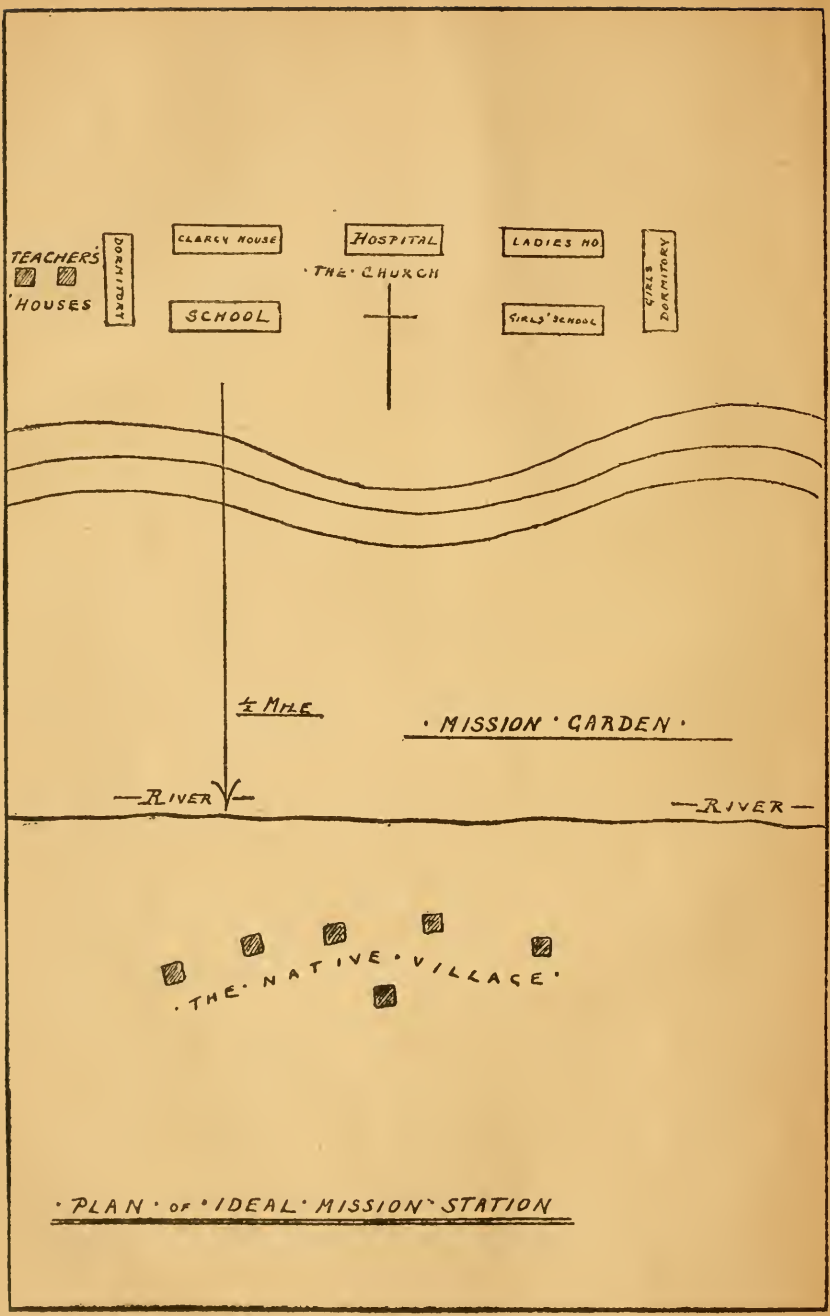
In the case of a new station on the lake level, it would generally be possible to choose a dry site free from rivers and swamps, and to put the station one-third to half a mile back, on a small hill overlooking the lake. A native village on the lake shore, if it existed, might remain; and houses for retainers and servants might also be built on the lake shore. The intervening ground could be made into a garden and planted with fruit trees; plants requiring watering would be placed near the lake; ground only tilled in the wet season could extend right up to the station. Native teachers' houses, if built on the station, would be at one end of it, and *on no account should they be built between the station and the lake, as this would destroy isolation.*

In the case of an inland station (e.g. a hill station in the Yao country) the same general plan should be followed; the water supply (and the anopheles breeding-ground) would be a river or stream, and not the lake; and it would be best if all the native huts were on the opposite side of the stream, and if the Mission garden, unoccupied by houses, came right down to the stream on the near side.

Appended is a rough sketch of the sort of plan that would be ideal from the health point of view (p. 78).

Note on Visits to Native Villages, etc., at Night.—Whatever personal care is exercised and whatever precautions are taken as to the sites of stations, and even if they were rendered entirely free from malaria, protection cannot be absolute, for it is not possible for Missionaries always to remain on the station after sunset. If the steamer calls at night, it may be necessary to go down to the lake shore, and the priest-in-charge or the nurse may have to go down into the native village. In each case some risk is run, but it should be undertaken as a matter of course, where necessary; *where unnecessary, it should, equally as a matter of course, be avoided.* What is wanted is not unreasoning alarm which supposes that any exposure will be followed by an attack of malaria, but a quiet recognition of the fact that *malaria is an infectious disease, and that infection is present after sunset in practically every hut in a village.* One's attitude of mind should be similar to that in which one approaches any other infectious disease, viz. a determination not to expose oneself unnecessarily, and yet an equally strong resolution not to omit any duty through fear of infection.

Education of Public Opinion.—Whatever precautions are taken, and however carefully stations are planned in the first instance, nothing will avail without the education of public opinion. Members of the Mission must endeavour to understand the facts of the mosquito malarial theory, and to appreciate the bearing of the precautions enjoined, otherwise they may, by acts of thoughtlessness, destroy those safeguards for their own health which have taken much care to build up. For the most part people are willing to accept the facts and to carry out the instructions laid down, but



PLAN OF AN IDEAL MISSION STATION.

they often do not really understand them or appreciate their exact bearing or importance, and so they make mistakes. With this end in view, a short summary of the mosquito malarial theory and its application to the various stations in the diocese, together with a statement of the special precautions that should be observed at each station, has been printed in the Diocesan quarterly paper. A copy of this is here appended—

FROM THE LIKOMA DIOCESAN QUARTERLY PAPER, APRIL, 1904.

THE PREVENTION OF MALARIA.

During recent years, great and far-reaching discoveries have been made which should teach us what precautions to adopt in a malarial country. It must be confessed, however, that very frequently the facts are misunderstood and misquoted. It is only too common to hear ridicule poured on the "Mosquito theory of Malaria" by persons who have never taken the trouble to find out what that theory is.

Hence it may be worth while to recapitulate these discoveries as briefly as possible, and to endeavour to deduce from them the precautions which should be adopted at the various stations of our Mission.

Malaria is a disease acquired by inoculation, just as vaccination is. The inoculating instrument is the proboscis of a mosquito of a particular genus, called Anopheles. The poison inoculated is the Malarial germ, which has been sucked up with the blood of a patient who is suffering from Chronic Malaria (generally a native child) about a fortnight previously, and which has come to maturity in the body of the mosquito, and finally reached the proboscis ready to pass out again.

As far as the mosquito is concerned the whole process is accidental. It only aims at getting its feed of blood regularly. If it feeds on a patient with Malaria the development of the germs in its body give it neither inconvenience nor advantage. The Malarial germ has taken advantage of the blood-sucking habits of the mosquito to secure its transmission from one human being to another.

Such are the facts; now let us deal with some of the fallacies often stated.

1. This theory applies to *infection* with Malaria. It is well known that relapses may occur without any fresh infection. They occur in England as well as in Africa. The theory does *not* say that *every attack* of Malaria is caused by the bite of an infected mosquito, but that the *first* attack always is. How far subsequent attacks are mere relapses and how far they are fresh infections often cannot be determined, but it is obvious that the fewer fresh infections a person gets, the better his chance of keeping free from malaria.

2. Only one particular kind of mosquito is the culprit, viz., Anopheles. The other principal kind, Culex, does not convey Malaria.

On our Mission stations, Culices are generally more plentiful than Anopheles and they are much more to the fore. It is mainly they who bother one during dinner and in the evening. Anopheles frequent, particularly, native dwellings, for there they get a good chance of a feed night after night. During the day they hide in the dark parts of the house. For the most part they bite at nights after lights are out and all is quiet. They attack during sleep and often their bites are not noticed in consequence, for with all blood-sucking insects the irritation of the bite is much greater if the creature is disturbed. To begin with, it injects an irritating fluid. If it gets a good suck it draws most of this out again, if it is disturbed, the fluid remains and causes swelling and irritation. A nibbling mosquito or flea is much more annoying than one that gets a good bite.

These facts explain three statements which are often made and are supposed to refute the mosquito theory, viz.—

(*a*) "I have often been terribly bitten by mosquitoes, but have not had malaria in consequence." Answer. The mosquitoes were culices, so this is easily explained.

(*b*) "I have never been bitten by mosquitoes, but have had malaria." Answer. The bites of anopheles occurred during sleep, and passed unnoticed.

(*c*) "There are no mosquitoes here, but people suffer from fever." Answer. This generally means mosquitoes are scarce; what there are, are Anopheles, and their night attacks are not observed.

3. Thirdly, the *Anopheles must have been infected with Malaria and the germs must have had time to come to maturity.* Fortunately for us the percentage of anopheles thus equipped is small, so that one can frequently be bitten by anopheles before one is unlucky enough to be bitten by an infected one, just as, though a lancet is the instrument of vaccination, one could scratch oneself hundreds of times with no result until one got a lancet charged with active lymph.

The source from which the anopheles derive infection is nearly always native children. Contrary to what is often supposed it has been shown that natives are not naturally immune to Malaria. Practically all native children under five are in a chronic state of latent Malaria. They may seem well, but they have parasites in their blood. Many children in fact die from Malaria, those that grow up have acquired considerable immunity. The native of twenty is on a par with the white man who has been twenty years in Africa, and both are to a great extent immune against Malaria.

Further, mosquitoes are poor fliers. They very seldom travel a quarter of a mile, and never a half mile, from the water in which they are bred, and to which they return to lay their eggs. Hence in considering the site of any station a knowledge of their breeding-places is of prime importance. Culices breed in any stagnant water, often in artificial collections, such as tanks and pots and tins thrown away in the neighbourhood of houses. If they are bad in any place, a hunt will almost invariably reveal their breeding-ground close at hand. *On every station all tins, etc., should be collected and buried in a pit before the rainy season begins.* During the wet season, a space should be hoed clear of grass round all kitchens, etc., so as to avoid cover where such tins can lie hid. The observance of this rule would add greatly to the comfort of all residents.

Anopheles breed mainly in natural collections of water which are not quite stagnant, but kept fresh by rain, or by a trickle of water through them. Thus they breed at the edges of streams, in pools near the lake shore, in water holes and rice fields. Young fish destroy the grubs, so they do not exist in the lake itself, nor in streams where there is a good flow of water. In the dry season anopheles breeding-grounds may be absent, but the mosquitoes can live on for months in native houses, so this fact only reduces their numbers and does not exterminate them.

The above is a summary of the facts of Malarial infection as worked out by the Royal Society's Commission and the various expeditions from the London and Liverpool Schools of Tropical Medicine. Let us now consider their application.

Three possible methods of preventing Malaria have been propounded.

(1) *The extermination of Anopheles* by draining their breeding-places, thus preventing the carrying of infection. This has been attempted in some towns on the West Coast, but in this country it is only applicable to a limited extent, for owing to the scattered character of the European population the cost of its general application would be quite prohibitive.

(2) *The extermination of Malarial parasites in natives* by the compulsory administration of quinine twice a week. This has been adopted in some German colonies, e.g., at Dar-es-Salaam; but it is not feasible here.

(3) *Avoidance of the bites of infected mosquitoes.* This is the method that must be aimed at by members of the mission. It may be procured by:

(*a*) Special precautions, applicable to the individual.

(*b*) General precautions as to the site of the Mission station.

(*a*) Under special precautions come:—

(1) The *constant* and *intelligent* use of Mosquito nets which are free from holes. In view of what is said above about the night habits of anopheles, this is of prime importance.

(2) As far as possible, after sunset, waiting about on the lake shore, or in native villages, where infected anopheles are sure to be present, should be rigorously avoided.

(3) During the evening, when Mosquitoes are troublesome, wearing gaiters or two pairs of socks, fumigation with pyrethrum powder, and the use of oil of lavender, help to protect from mosquito bites, and also conduce to the comfort of the individual.

(*b*) General precautions as to the site of the Mission station aim either at *Isolation* or *Segregation*, or at a combination of these.

By Isolation is meant securing freedom from anopheles by building the station at a distance of a quarter to half a mile from any of their breeding-places.

By Segregation is meant separating the European dwellings by a like distance from native dwellings, then, even though anopheles were present, they would not get the opportunity of becoming infected and would be harmless. This method, which is the simplest and the most certain, has been employed largely in India and in some Government and trading centres on the West Coast. It is obvious that it is only partly possible in a Mission station. Complete segregation of European dwellings is impossible. School boys and girls must sleep on the station. It is possible, however, to arrange that all married workers should live, with their children, away in the village, and thus, by removing the children under ten, most of the objects of segregation would be secured.

These are doubtless counsels of perfection (particularly as regards the ideal distance of half a mile which could only be carried out completely in planning a new station), but they have also an application, and suggest precautions, as regards our existing stations.

At Likoma, anopheles breed freely both at Ngani and Mbamba, and the lake shore must be regarded as decidedly malarial. The good health record of Chipyela is almost entirely due to its isolation. It is over a quarter of a mile from the villages and comparatively few anopheles manage to fly the distance. *It is of the utmost importance that this isolation should be maintained.* No houses should be built in the intervening space, and such as exist towards Ngani should be moved on the first opportunity. Such houses act as resting-places, which make it easier for the mosquitoes to travel the distance. For the same reason, *any extension of the station should be away from the lake.* Had the station been built originally a quarter of a mile further from the lake on the path towards Kuyu it would probably have been quite free from Malaria.

At the College, anopheles breed close to the lake shore. The nearest College buildings are within 250 yards of the lake and there is a native village only 300 yards off, which is probably the main source of infected anopheles. Thus, though standing alone, the College is not effectually isolated. In order to increase the isolation (and every 100 yards gained is a distinct advantage) the following recommendations should be observed.

1. All new buildings, especially dormitories or teachers' houses, should be built further away from the lake towards the football field. In this way an additional 150 yards, tending towards isolation, might be obtained, and the buildings on the brow of the hill might be those in use only in the day time, viz., school, kitchens, etc.
2. On no account should any houses be built between the College and the lake.
3. All disused bango houses should be cleared away, as these harbour mosquitoes.
4. The number of married persons, with families, sleeping on the station should be reduced to the absolute minimum.

At Malindi, anopheles are scanty, but such as occur breed on the lake shore close to the station. Isolation is not possible, but segregation to a great extent exists. Except the "Mission Village" there are few native huts within a quarter of a mile on either side. It is most important that no more should be built within this limit, and, where possible, the existing ones should be moved.

If the opportunity occurred for buying the land for a quarter of a mile north and south, it would be most advisable to do so, as it would be a greater security to the health of the station.

In the "mission village" the houses should be few but good, and as few families as practicable for Mission work should live there. New houses might be built, as required, 100 yards further away, and so the village gradually moved rather further from the station.

All tumble-down houses should be cleared away.

At Kota Kota the station is surrounded by native huts and also by anopheles breeding-places. No measures of isolation or segregation are possible. The prevention of malaria must be confined to the careful observance of the rule for personal protection: the mosquito proofing of all European dwelling-houses, together with the intelligent use of the means of protection thus afforded: and the routine administration of quinine as a preventative. The good health record of Kota-Kota is probably due to the fact that mosquitoes (the great majority of which are Culices) are so abundant that persons are driven for comfort's sake to adopt those precautions which, when mosquitoes are few in number, they are too apt to omit.

At Mponda's the conditions are similar, except that anopheles are relatively much more abundant and hence less easy to avoid; precautions must be similar to those enumerated for Kota Kota.

An examination of statistics shows the most remarkable improvement in the health of members of the Mission during the last five years. This is mainly due to the more general adoption of precautions against malaria. There is, however, considerable scope for the development of, and for the more intelligent and general adoption of such precautions: and there is no doubt that such a course would mean a corresponding benefit to health, and so an increased capacity for work for all members of the Staff.

The education of *native* opinion is a difficult matter, and even if the need for avoiding mosquito-bites were fully appreciated, it is doubtful how far they would be able to better their surroundings on a large scale. A few individuals might build their huts on healthier sites, but any comprehensive scheme for the improvement of native villages would have to be carried out by the sanitary department of the Government, and at present there seems little prospect of such being undertaken in British Central Africa. However, an endeavour is made to teach the fact that anopheles do convey malaria, and that mosquitoes breed in water, as shown by the appended extract (from the native Mission paper, *Mtenga Watu*), written by one of my dispensary boys, after due instruction in the subject.

FROM "MTENGU WATU."

LIKOMA.

February 9, 1904.

MOSQUITOES.

(*Translation.*)

There are two kinds of mosquitoes, (1) the male, which cannot bite man but lives on fruits, such as banana, and only lives for perhaps two days and then dies quickly. (2) The female, which bites man and sucks the blood; it goes to water and lays eggs; this kind can live for two or three months if it is sucking blood well [1] *every two or three days.* Its eggs float on the water for three days and then hatch, and its little offspring appear in the water like little worms. After two weeks these little worms become like "*big-heads,*" [2] the "big-heads" you know well and always see in pools and little streams in rainy season. Then after two days these little "big-heads" change, and become real full-size mosquitoes.

[1] The text says "sucking blood well for two or three days," but I think the writer meant to say what I have rendered it.

[2] By "big-heads" the writer evidently means some small pond creatures, perhaps tadpoles for aught I know, but I have simply given the significance of the native name for it.

There are two families : the one is called " Culex." This kind is recognized by the fact that its little worms as they appear in water put the tail end uppermost *in the water* and the head downwards ; moreover, they can live in any water, even in a pot, or useless tin, thrown away.

Of the second family the name is Anopheles, which means " no good." This kind is recognizable by its little worms lying horizontally on the water and they appear in pools and streamlets, not in water standing, as in pots. But in the streams and pools they only appear if there are no young " mademba," [1] because if there are young " mademba " in a river they will quickly eat those little worms ; for the same reason these little worms cannot live in the lake, because of the innumerable young of small fishes ; so, also, in a pool, if young " mademba " come, the little worms will be soon eaten up.

Also by this kind of mosquito a person can be infected with malaria fever. Its origin is as follows : The mosquito sucks the blood of a person who has malaria, and in the blood of that person are tiny things invisible to the eye, called germs, and these little germs grow in the body of the mosquito for two weeks and after that, if that mosquito bites another person, it can convey to him those fever germs and that's why it is people are constantly having fever. If there were no mosquitoes, nobody could have fever.

[1] Mademba is the name of a very small variety of fish, and as I don't know how to classify it properly I have used the native name.

N.B.—" Little worms." I have used this literal rendering instead of larvae, which I suppose to be meant.—(*Translator.*)

PART IX.

Our Need. A Hill Station.

Up till now, the past and present condition of the Mission has been considered and we have only looked forward to the future when enumerating possible developments or improvements of the individual stations.

It is now necessary to *look forward* and to see whether any considerable extension of the Mission might benefit the whole Mission from a health point of view.

As far as can be seen, no extension on the lake itself or on the lake level would have such an effect. Likoma is probably as healthy and generally suitable a site as can be obtained on the lake level. An increase in lake stations would mean a development of work, but it would not have any specially beneficial effect upon the health record.

As regards the steamers, the *Chauncy Maples* is quite new, great forethought was expended on it, and it has been made as up-to-date as possible; it is in the highest degree improbable that another steamer will be even thought of, at any rate, for many years to come.

On the other hand, extension *inland* up into the hills, on the east side of the lake, among the Yaos, has long been dreamed of and hoped for. This extension carries with it great possibilities. It may not be possible to foresee how far such a movement would develop, or to estimate what its exact reflex effect would be on the health of the Mission as a whole; but it is opening up new ground, extending into a higher country with a cooler and more bracing climate, and getting into the midst of a numerous, powerful and intellectually superior race. A hill station need not necessarily be any more healthy or any less malarial than a lake station, as shown in the case of Unangu. The cooler climate is pleasant, but in itself it does not prevent malaria. If the station is to be a success from the health point of view, it is of primary importance that the site should be selected with care, and that the whole station and its surroundings should be planned out from the hygienic standpoint. If this be done (as already pointed out) a station practically free from malaria should be secured. Then, the cool bracing climate would be added to the freedom from malaria, and should have its full benefit. Moreover, this benefit should be extended to the residents at other stations, for, if the hill station became an accomplished fact, it would be possible for those workers on the lake who are jaded and worn out and need a change to get a fortnight's or a month's

holiday in a bracing air; and further, provided the station were within fairly easy reach of the lake, those who have just recovered from severe fever, or who are actual invalids, could be landed from the steamer and sent up to the hill station hospital to recruit. Thus the general health record of the diocese should be improved, and, very possibly, a periodical month's holiday under such favourable circumstances would enable workers on the lake level to stay out longer than they would otherwise be able to do.

It seems fairly certain that these results would follow the establishment and adequate equipment of a healthy European hill station. It is possible that its effects might reach still further. The time might come when the printing office, carpenter's shop, etc., would be established in the Yao hill country, possibly also there might be a Yao college, and gradually the ideal of a chain of stations reaching away to Masasi and the coast might be realized. The latter developments are, however, all in the dim distance; for the present it is only possible to look forward to the establishment of one hill station, fairly near the lake. This has been contemplated and indeed planned out on more than one occasion during the last decade, and it is only the smallness of the staff, and more particularly of the clerical staff, that has prevented it. *Its realization may be put down as the most pressing need of the near future, from the medical and hygienic point of view.*

The experience of the other Missions on the lake (the Mvera and Livingstonia Missions) has led them to establish their headquarters, and concentrate their work mainly on hill stations, and though our Mission will probably always have its headquarters and much of its work centred among the Nyasas of the lake shore, yet the time for extension backward into the Yao country would certainly seem to have arrived. In addition to the advantages already mentioned would be the possibility of maintaining a far better garden than can be made at the lake level. Fruit and vegetables grow much more freely in the cooler climate with a better distributed rainfall, and a hill station should be able to supply all our other stations.

The Site of a Hill Station.—As stated above, it is most essential that the hill station should be suitably situated. Ideally it should be 3,000 to 4,000 feet above the sea (i.e. 1,500–2,500 feet above the lake) and yet within fairly easy reach, if possible, within a day's machila journey, of the lake. Also, with a view to developments, timber, building material, etc., should be obtainable, and food, both native and European, and labour should be plentiful. Lastly, from a Mission point of view, it should form a good centre for work in the surrounding country, and therefore should be placed where there is a considerable population in the neighbourhood. The Yaos have now left the hill fortresses to which they fled for safety from the Magwangwara, and have returned to their usual mode of living, and they are scattered in small hamlets over wide tracts of country. Hence the

actual site of the hill station will not be determined, as often on the lake, by the presence of a large town or village in the neighbourhood, so that it should be possible to choose it mainly on the score of health.

The only place which would seem to fulfil all the above requirements is the region of Mtonya (see map, p. 38). The old hill fortress stood on the slopes of a mountain, as in the case of Unangu. Now, the people are scattered through the surrounding country, but the population is considerable. The soil is fertile and food is plentiful, and timber and building material should be easily obtained. The mountain rises out of a rolling table-land which is between 3,500 and 4,000 feet above the sea. The distance from the lake shore at Lungwena is thirty-five miles ; it is a fairly easy path and it could be covered in the day by machila. The country round is well watered and in places it is swampy, so that care would be necessary to avoid the neighbourhood of anopheles breeding-grounds. Probably the most suitable site would be found on the lower slopes of the mountain, rather above the tableland, near the site of the old town.

The country round is delightful. Away to Unangu, fifty miles to the north, and to Malindi, seventy miles to the south, stretches a well watered and wooded rolling plateau 3,000-4,000 feet above the sea level, out of which rise conical or dome-shaped hills to a height of 1,000 or 2,000 feet.

Zarafi's Hill or Fort Mangoche.—Between 1896 and 1898 this site was much talked of as a suitable one for a hill station. It is only sixteen miles from Malindi (see map, p. 38), but is 4,500 feet above the sea (3,000 feet above the lake), and commands a magnificent view over the valley of the Lujenda to the east and the Upper Shiré, to the west. Zarafi's hill fortress was built on a flat saddle of land, above which the bare peak of Mangoche hill rises at least another 1,000 feet. He was a powerful chief and had between 5,000 and 10,000 people around him. After his defeat, by the British Central Africa Government forces, his people all became scattered and the magnificent site was forsaken. It was, however, soon occupied by the armed forces and has now been made into a barracks and military fort. Zarafi's people are returning, but not to the hill, they are scattered about the table-land, out of which the hill rises, at least 1,300 feet below (i.e. 3,200 feet above the lake) and at least one and a half hours away from the old town.

Thus, though the site has many natural advantages, the fact that the Yao inhabitants have moved away, and that their place is taken by a military barracks, prevents it from being any longer suitable. For purposes of Mission work it would not be feasible to be separated by a distance of one and a half hours from the nearest school. Moreover, the proximity to the fort and the fact that there is only one other European in the neighbourhood, and he the military and civil governor of the district, is a distinct drawback. Lastly, there is one natural disadvantage that was not realized

when its claims to be an ideal site were advocated in England, viz., during most of the wet season, from November to April, it is frequently right up in the clouds, with a chilly Scotch mist all around. This may not be unhealthy to residents, but it is unpleasant, and prevents it from being suitable for a holiday and recruiting station.

Namizimu Mountain.—In 1902, after the recent troubles with the Portuguese, it was thought that it might be an advantage if a suitable site could be found in British territory, and, with this in view, the country behind and to the north of Malindi, up to the Anglo-Portuguese boundary line, was explored. The difficulty is that the country is very sparsely inhabited and no site surrounded by a considerable native population, as is the case with Mtenga, was found. In Namizimu mountain, however, is a region that may possibly be suitable for future developments. It is a fine cluster of hills, the slopes and valleys of which are well watered and well wooded, lying just behind Kadango, only fifteen miles from the lake (see map, p. 38).

The peaks rise to a height of 5,600 feet above the sea, but about 1,000 feet below (4,600 above sea, and 3,100 above the lake) are some fairly level ridges similar to that on which Fort Mangoche is built.

It would probably be easy to find an ideal site for a station on the slopes of Namizimu, but at present the country is uninhabited, as it is believed to be haunted by spirits. Game is plentiful and elephants still roam there. On account of the lack of inhabitants and the consequent lack of food and labour and opportunities for Mission work, it is not suitable for the first hill station; but it is quite possible that it may be the site of the Yao college of the future, or some other extension of the work. The Yaos are constantly moving about, and it is very possible that something might determine them to settle near Namizimu.

PART X.

Notes on Special Points.

Little danger from Chills.—The range of temperature shows a very slight diurnal variation, often not more than 10°F. for the shade temperature (see p. 15). What is true of Likoma holds for all the stations on the lake level. In this marked uniformity of temperature the climate differs entirely from many other tropical regions, where there is a sudden fall of temperature at sunset. The result is that the special liability to chills, which is a peculiar danger in many tropical climates and which takes so prominent a place in most hints on tropical hygiene, is here practically absent.

It is certainly quite unnecessary to wear a cholera belt, and although those who perspire much should wear flannel or cellular garments next the skin, yet many people can wear cotton with perfect safety. It is certainly advisable to change one's clothes when they are soaking wet from perspiration or from rain, just as one would do in England, but the danger from chill, if unable to do so, is probably no greater here than at home.

Chill is often put down as a cause of an attack of malaria, but my own experience out here leads me to say that the causes where I have found this a determining factor are remarkably few. The feeling of chilliness which is the first symptom of the attack is often put down as its cause.

Sanitation, Native and European.—Among the natives, sanitation is conspicuous by its absence. They "go to bush" where there is suitable cover, often along the sides of streams or among the reeds or rocks of the lake shore. In the dry season the tremendous disinfecting power of the hot sun probably prevents any danger of infection, and, beyond unpleasant but harmless smells, no evil results. In the wet season, however, sewage must be washed into the streams and the lake, and pollution of the water results.

At night time the fear of wild beasts or witches prevents the people from going any distance from their houses and they "go to bush" close by. The result is an infection of the soil in the neighbourhood of native villages, and it is probably in this way that ankylostomiasis and (possibly) bilharzia (both of which, and especially the latter, are extremely common diseases) are spread.

This total absence of sanitation does not become a nuisance where the people live in small hamlets scattered along the lake shore or through the forest, but when they are collected into a big village or town like Kota

Kota it tends to become a very real nuisance. In the dry weather the sun dries up the excreta rapidly, but in wet weather the town is often abominably smelly.

In the case of natives living a little way inland (e.g. the boys living on the Mission station), they use any suitable cover as a latrine, and as this is at a distance from any water there is not any special danger of pollution. It is difficult to see that much can be done to improve native practice in this respect. In the case of school boys and girls, trench latrines are provided, but though they are generally used at night, so as to prevent a nuisance near the dormitory, it is often very difficult to insist on their use in the day time and they prefer to " go to bush " far afield. Cultivated ground is never used as a latrine ; it is a great offence in native law to commit a nuisance in another person's fields.

No general system of sanitation could be enforced without a considerable amount of compulsion, and such compulsion would have to be exercised by the Government, and it is extremely unlikely that any general sanitary reform will be attempted, on account of the scattered condition of the native population and the small number of white people in the country. Indeed there is only one Government medical officer on the lake, the Government officials " taking their chance " or relying on the charity of the Missions.

As regards Europeans, the system employed is simplicity itself, and yet it is sanitarily sound. It is simply the old-fashioned cesspit system. A pit about three feet across and six feet deep is dug and over it is erected a small reed house. When the pit becomes nearly full it is filled in, another is dug and the reed house is moved. The excreta are thus buried safely in the earth. As these pits are always dug at a distance from any water supply there can be no danger of infection.

The only possible objection to this system is that the pits might be offensive. As a matter of fact this is not the case, provided a sufficient number are dug and too many people do not use the same one. As a rule, one such pit should be provided for every two Europeans, and at least one for every three persons. If this is done, there is practically no smell, or, at any rate, if it should be offensive in the hot weather, a little Jeyes' powder will check the smell.

Such a system, of course, presupposes that the size of the Mission property be ample to provide room for such pits ; but this is the case in every station. It is, of course, not a system that could find favour in a European town, or indeed, anywhere, except in the case of houses standing in their own grounds. In the case of towns there would have to be some general earth closet system controlled by a proper sanitary authority. Such a system would, however, appear to offer no advantages if applied to our Mission station. The night soil would have to be disposed of in pits in the same way as at present, while, owing to the great natural repugnance for such

work which exists on the part of natives of this country, it would be a constant source of worry to arrange for the clearing away of such night soil from the earth closets.

The Lake Water.—As stated above, where the lake water is drunk, water-borne diseases (such as dysentery and typhoid) are rare, while cholera is not known. At both Kota and Mponda's, however, where water from rivers or water holes is drunk, dysentery is fairly common, especially at the time of the year that water gets scarce, viz., at the end of the dry season. Typhoid fever, indeed, was believed to be absent from the Protectorate until quite lately. During the last few years undoubted cases of typhoid have occurred, both among black and white inhabitants. It is probable that infection was in the first instance brought up from South Africa by persons returning from work in the mines.

Apart from undoubted cases of typhoid, other cases of prolonged pyrexia have occurred, some of which were probably a typical typhoid attack, and it is certainly possible that such cases may have existed but not been recognized in past years. At any rate, the presence of undoubted typhoid in the country must now be acknowledged and it must be regarded as a danger for the future. In view of what is said about the absence of native sanitation, it is easy to see how infection could be carried; indeed, it is hard to see why water-borne diseases are not much commoner. The explanation would appear to lie in the fact that people for the most part drink lake water, and it must be difficult for infection to be spread by the lake. One imagines that it must be possible for lake water drawn just at the mouth of a polluted stream to convey infection (although there is little positive evidence on this point), but if infection thus reaches the lake, it would appear soon to be destroyed. Such an appalling calamity as the infection of the lake with typhoid germs and their multiplication in it is, I imagine, beyond the bounds of possibility. If such were possible, it would probably have already occurred in the case of the great American lakes.

On the other hand, if infectious germs quickly lose their vitality on reaching the lake, it follows (as has been generally accepted) that the great mass of water (the lake is 360 miles long and in places 240 fathoms deep) must be pure and quite safe to drink unboiled. As already stated in the account of the steamer, it has been the custom to drink such water drawn well out where the lake is deep, and no harm has resulted. My own opinion is that such water is perfectly safe, but I should be glad of the opinion of the Medical Board on the subject. If such a thing as the infection of the whole of lake Nyasa with typhoid is possible, it would mean the decimation of the inhabitants of its shores. In the case of all the stations it is the rule that all drinking water should be boiled (except at Kota, where it is naturally sterilized). This is to guard against the danger of pollution

that must exist in water drawn at the lake edge, close to the mouths of streams; in the case of the steamer, it was argued that similar sewage pollution might occur when she was anchored, hence the existing rule that water should be drawn at some distance away under these circumstances, but it has been, and still is, the custom for passengers by steamers and boats to dip up and drink unboiled water from the open lake.

Danger of Overwork and Understaffing.—On this point I think that opinion at home rather overstates the danger. People are inclined to think that a special danger attaches to overwork in Africa. The result is that some new members come out with the idea that they must be most careful never to overdo themselves and never to tire themselves out, etc. As a matter of fact, at any rate up at Nyasa, a man or woman can do just as good a day's work as in England, and they should come out prepared to do so. Hard work is good for everybody out here, as in England. Overwork is bad, but so it is in England, and I do not think it is any worse out here. On an emergency, it is very distinctly possible to overwork (i.e., to work *for a time* longer hours and at higher pressure than one can possibly keep up), and yet if one gets a rest when the emergency is passed no harm need result. In some quarters there is, I think, a tendency to maintain the staff so that they can cope with emergencies without overwork; this is, I think, a mistake; what one wants is to maintain a staff that can just comfortably get through the work by dint of every one working hard, then, if an emergency comes, people will rise to it. This is the system on which a clergy house is staffed in England, and it should be the same here.

On the other hand, strain and worry tell out here perhaps more than they do in England. Understaffing (i.e., where, after a full day's work, a man goes to bed feeling that things which ought to be done have not been done, and thinking that by cutting down his sleep or by driving a bit harder next day he can get in a little more) undoubtedly means, in the case of most workers, strain and worry. In England, this tends to nervous breakdown; out here, perhaps, it shows its effects rather sooner, in irritability and an attack of malaria. In short, what is wanted is not (as I think some people at home would like) overstaffing, nor understaffing, but an *adequate* staff.

On the other hand, in order to *maintain* an adequate staff out here *it is necessary to calculate as if one were going slightly to overstaff;* unforeseen accidents, deaths, invalidings, etc., are always robbing us of some members and upsetting our calculations, so that, in order to avoid understaffing, it is necessary to have some spare workers in reserve, ready and waiting to come if called on.[1]

[1] At the present moment our Nyasa staff is adequate as regards ladies and laymen, though *as regards clergy we are seriously understaffed.* But for the lack of clergy we might be at Mtonya at the present time!

Cultivation and Gardening.—It must be admitted that gardening has been rather neglected in the Mission. It has been taken up by a few enthusiastic members, but, when these have passed away, their labours have not been carried on as they should have been. But even so, the legacy that they have left to the various stations has been of the greatest benefit. Thus, Kota Kota owes most of its fruit trees to Sim ; at Malindi there is the nucleus of a good garden, planted by Bradshaw ; while Likoma has until quite recently been entirely dependent on the garden planted at Utonga by Archdeacon Johnson.

Little can be done at Likoma on account of the barrenness of the soil, but all the other stations should have a good garden. The upkeep of the garden should be undertaken as a definite work by some member of each station ; it should not be a mere hobby, but a real effort should be made to benefit the station permanently by planting fruit trees, even if they take years to come into bearing.

It is never likely that our Mission will go in for farming on a large scale like our Scotch and Dutch neighbours, and we are never likely, like them, to have members of our Mission whose work is to be agriculturists. Still, if any one intending to come out here were to acquire a good practical acquaintance with gardening and fruit growing, his knowledge would stand him in good stead and be of real practical benefit to the Mission.

PART XI.

Notes for the Medical Board.

On the working of "The two years rule."—This rule, viz., that the first furlough should take place at the end of the first two years of completed service in Africa, came into force in 1899, the grounds on which the rule was promulgated being :—

(1) The fact that Mission statistics showed that out of seventy-four deaths, forty-five had occurred during the first three years of service ; and

(2) The fact that statistics proved that the liability to blackwater fever was greatest during the third year of residence. (N.B.—Dr. Daniels, working out the blackwater fever statistics for British Central Africa in 1899–1900, came to the conclusion that incidence is practically equal for the second and third years, and after this that it very rapidly decreases.)

It was argued that if workers were to come home at the end of two years they would be saved the special risks of the third year, and hence that the mortality would be greatly decreased.

There seemed no flaw in this argument, and it only remained to test it by experience. It has now been in force some five years, and a number of workers are now in the third year of their *second* term of service, so that it is possible to see how far experience demonstrates the truth of the argument. One contingency was obviously left doubtful, and could only be answered by experience, viz., given a person who would have suffered from blackwater fever during his third year, but who was saved from this disease by spending his third year in England, would he start fresh the following year, after furlough, or would the attack occur just the same during his third year of African life ? The answer to so difficult a question can only be given after a longer time and after more facts have accumulated ; but two cases have recently occurred which suggest that the answer may be less favourable than was hoped. Mr. C. C. and Mr. D. D. have both suffered from blackwater fever during their third year of African life, in spite of the fact that the previous year (i.e. their third year of service in the Mission) had been spent on furlough in England. These two cases would seem to suggest that the interposition of a furlough in England does not prevent the continuance of that unknown process which in certain persons causes a predisposition to blackwater fever. As bearing on this point, it may be mentioned that Mission experience seems to show that, after one attack, residence in England, even for three years,

does not diminish the liability to a second attack soon after return (as shown in the case of Mr. E. E.). The case of F. F. is even more striking, for in his case the liability to blackwater fever seems to have been acquired during a three years' residence in Africa, although he did not have an attack, and two years' residence in England did not abolish it, for, six months after his return, he had blackwater fever. Of course, these few cases must not have too much emphasis laid on them, but as far as they go, they seem to indicate that the alteration of the time of furlough will not have a definite effect in reducing the number of cases of blackwater fever, as was hoped.

C. C., April, 1899–September, 1901. Working in mainland villages for eight months and then at Likoma. Returned from furlough, September 1902. *Blackwater fever*, January, 1903.

E. E. July, 1888–February, 1892. At Likoma and on *Charles Janson*. "A good deal of fever." In August 1892, went to Fort Johnston. *Blackwater fever* early in 1893. Invalided. At home till November, 1896. Early in 1897 *blackwater fever* at Likoma, did two years' work afterwards on *Charles Janson*, and left in April, 1899.

F. F., 1890-1893. Worked in Zanzibar as a layman. Mild attacks of fever, 1893–1895 at Dorchester. October, 1895, at Likoma. *Blackwater fever* in 1896, in April, and again in May. Invalided. Returned, May, 1897. Died from third attack of *blackwater fever* in August, 1897.

In other respects, however, experience seems to show that the "two years' rule" has been an unqualified success.

There seems to be no doubt that the third year of the first period of service was a bad one for health, apart from the occurrence of blackwater fever. It is not hard to explain this. Three years' absence from home is a long time for many people, and the disappointments, strain, worries, and illnesses incident to life out here begin to weigh heavily. Two years is a much shorter time for both the workers and their home relations to face,and this fact, in itself, gives encouragement. Anyhow, the result of the two years rule is seen in the fact that very few workers have been invalided ; indeed, during the last three years, none have been so, whereas, had they tried to stay out three years, some would almost certainly have had to be sent home. Another result is to be seen in the fact that the great majority arrive home in perfectly good health. This enables them to do work for the Mission while at home, and it should also decidedly diminish the time spent on furlough. Lastly, it does more than anything else to cheer up and encourage anxious relatives, and generally sends the worker back fully prepared to face four or five years for the second term.

In the old days, the idea seemed to be that furlough about every three years was necessary ; I believe that the division into a first period of two and subsequent periods of four or five years is far preferable. Even from the Mission point of view, it has much to recommend it. Frequent furloughs are a great interruption to work, but members, when they come out for a second time, are much more valuable, and settle down to work

much more quickly, so that the disadvantage of their early first furlough is more than counteracted by the advantage of their longer second period.

On Blackwater Fever.—The above note may seem at first sight rather discouraging, as tending to show that the interposition of a furlough need not prevent the occurrence of blackwater fever in those who are acquiring the tendency to it. Be this as it may, however, there is no doubt that a decrease in the amount of malaria among the European workers should be followed by a corresponding decrease in the amount of blackwater fever, and the Mission statistics show this to be the case. It was shown by the Malarial Commission that, on the whole, the amount of blackwater fever, in a locality varied in direct proportion to the frequence of malarial attacks. Hence the greater freedom from malaria that our stations show, the fewer will be the attacks of blackwater fever. Although this general correspondence exists, it is not, by any means, always in those who have the most frequent attacks of malaria that blackwater fever declares itself. Before blackwater fever develops, apparently, there must be acquired a predisposition to it. As to what this predisposition is we are still in ignorance, but before it is acquired there must be at least one and generally several attacks of malaria. Moreover, some people acquire the predisposition quickly while the majority never acquire it at all.

Given the predisposition, something occurring in the course of what is apparently an ordinary malarial attack determines the attack of blackwater fever. In a large number of cases the determining factor is a dose of quinine ; and, further, where it is quinine, it would appear to have been generally taken on a rising temperature. Before quinine can have this effect, the predisposition must be present ; and it certainly is not in those who use quinine most systematically, for the treatment of malaria, that blackwater fever is commonest ; it is much more common to find it in those who take casual doses of quinine ; people who feel a little out of sorts for two or three days and then take a dose of quinine. *Such casual doses are probably of no use, and are undoubtedly a source of danger.* Quinine, like any other drug, if given at all, should be given systematically. In the case of ordinary malaria, it is probably best to wait till the temperature is falling, after the first rise, before giving it, and then to administer it regularly. The attack of blackwater fever may be of all degrees of severity ; it may be so slight that the patient is unaware that there is anything special the matter with him until he finds he is passing haemoglobinous urine, or it may be one of the severest of illnesses. After an attack, recovery is often rapid, and with a little rest and change the patient recovers quite as good health as before. Under these circumstances, the predisposition to blackwater fever may remain, or it may have disappeared and not reappear again. On the whole, it is probably more common for it to remain, and patients who have had an attack

of blackwater fever are more likely than others to have another attack. Such patients should therefore be extremely careful how they take quinine. If they get malaria, they should go to bed, and their temperature should be carefully taken, and quinine should only be given with a *falling* temperature below 100° F. These precautions prolong the treatment necessary to cure the attack of malaria, but they involve less risk of determining another attack of blackwater fever. Speaking from memory, I think that experience in German East Africa has shown that the employment of such precautions very greatly reduces the number of attacks of blackwater fever, and many persons who have had one attack thus manage to escape any further attack.

The mortality has greatly decreased during recent years. The great thing needed is rational treatment, good nursing and nourishing food, and if those are at hand the mortality is very small. If they are absent it may be high (about 40 per cent.). Many un-nursed patients recover from the blackwater fever, but die from exhaustion, mainly owing to lack of proper nursing and nourishment.

The mortality of first and second attacks is approximately the same; subsequent attacks are often slighter, and one rarely meets with people who have had a large number, ten or more, of the slight attacks.

The Mission statistics for this diocese show a high mortality (viz. 40 per cent.), but this is due to the fact that most of the cases occurred before the disease was well understood. None of the last four cases have proved fatal. Three of the fatal cases were due to suppression of urine, and at least two others died from exhaustion after the urine had cleared. Parotitis occurred in two fatal cases and one non-fatal case. Haematemesis occurred in two cases and relapses of haemoglobinuria in two cases.

Of those who remained on at work after an attack of blackwater fever, two suffered from second attacks, from which they died, and two did a good period of work (two years and one year respectively) without any subsequent attacks.

Of those who were invalided home but were allowed to return, one died within a few months of return; one did one year's work and was then killed accidentally, and one has done two years' work without another attack.

In view of these facts and statistics, I would venture the following opinion on the vexed question of whether members should be invalided home after a first attack of blackwater fever, and whether, if due to go home about the time of the attack, they should be allowed to return.

I think that no rigid rule can be laid down; much depends on the character and severity of the first attack, and a good deal also depends on the attitude of the patient himself.

There can be no doubt that a patient who has had one attack runs a

definite risk of having a second attack by remaining out here. How far this risk can be reduced by caution in the administration of quinine and improvement of general hygiene, statistics have not yet been determined, but it is probable that the reduction is considerable. Hence I should never decline to invalid a patient after an attack of blackwater fever, however slight, if he wished to give up work and go home. On the other hand, if he wished to continue at work and was prepared to take a certain risk, I should be prepared to give him the chance, at any rate, where the first attack was slight. Another factor to be considered is the period at which blackwater fever occurs. Generally speaking, an early attack shows that the predisposition to blackwater fever has been rapidly acquired and is of bad import, while conversely a late attack carries with it a better prognosis.

If the attack was a severe one, and particularly if it occurred early, e.g. during the first two years of residence, I should advise against return. If a patient has a second attack, I should always advise against return, unless possibly the second attack were so slight as to be negligible.

Assuming that on these lines it is decided to allow a patient to remain at work or to return, after a first attack, I should endeavour by every known precaution to prevent the danger of a second attack. I should enjoin great precaution as to quinine and lay down definite rules, and I should endeavour to decrease, as far as possible, his liability to malarial infection. Thus, if the station where he had been working was a specially malarial one, I should advise his removal to the healthiest station available, or, if this were impossible, I should endeavour to improve as far as possible the hygienic and other conditions of the station, so as to counteract, as far as practicable, its natural unhealthiness.

As already stated, a furlough in England does not, it appears, in any way improve the patient's chances, hence, if furlough were due, he would leave for England, but if it were not due I should allow the patient to remain in Africa and to return to work as soon as a suitable rest and holiday had restored him to health.

I am aware that this opinion does not altogether accord with that expressed by the Medical Board in 1898; but our knowledge of the aetiology of blackwater fever has advanced since that date, by the recognition of the existence of at least two distinct factors in the predisposing and determining causes, and, further, by suitable methods of treatment the mortality has been reduced to at least a quarter of what it was, if not beyond that figure, while precautions, which will apparently reduce the danger of second attacks, are being formulated and tried.

Appendix.

Likoma Health Record Statistics.

LIST OF WORKERS, 1885–1898.

N.B.—Only those who have spent a considerable portion of their time (over six months) at Likoma are recorded.

Mrs. Swinny, 1885–1888. Much fever. Invalided Easter, 1888. *Died at sea* on the way home from "fever and exhaustion."

Rev. C. Maples, 1886–1895. Acclimatized. Had been nine years at Masasi. Good health. Drowned in Lake Nyasa.

Mr. J. Williams, 1887–1889. Had been eleven years at Masasi. Acclimatized. Good health. Drowned in Lake Nyasa.

Rev. L. H. Frere, 1885–1889 and 1890–1892. Much fever. Invalided for extreme anaemia.

Mr. C. Alley, 1885–1889 and 1890–1892. Frequent fever. Invalided; anaemia and enlarged spleen. Intended to return, but developed a tuberculous knee while at Dorchester Theological College and died from tubercular meningitis.

Mr. F. W. Wilde, 1891–1892. Had been three years at Magila. He was invalided for a "severe illness." *Died* after eight and a half months at Likoma from "*malignant fever.*"

Mr. L. O. Warner, 1888–1889. Invalided after six months. Frequent fever. Constitutionally unfitted.

Miss M. E. Woodward, 1888–1892 and 1893–1896. Had been three years in Zanzibar previously. Good health.

Nurse McLaughlin, 1888–1892. Good health. Left because of fire.

Dr. J. E. Hine, 1889. Invalided after seven months, Fortnightly fever with hyperpyrexia. Returned to Zanzibar, 1891–1892. To Likoma, 1893 and 1896–1901. Poor health. Frequent slight attacks of fever which he disregarded.

Miss Fountaine, 1891–1892, Had been ten years in Zanzibar. Good health. Left because of fire.

Miss Turner, 1891–1892. Fair health. One year no fever, then rather frequent attacks. Left because of fire.

Mr. R. W. Lewis, 1891–1892. *Blackwater fever* after one year. Invalided. *Died at Durban.*

Rev. G. W. Atlay, 1892 and 1894–1895. Poor health. Much fever. Exposure, owing to lack of houses, due to the fire. Invalided from Chisumulu in 1893. Fair health during second period. Killed by Magwangwara.

Mr. B. W. Pullinger, 1892. Invalided after nine months for frequent fevers coupled with lack of houses owing to the fire. Could have returned, but withdrew.

Right Rev. Bishop Hornby, 1893. Poor health. Constitutionally unfitted. Invalided, February, 1894. Resigned.

Rev. J. S. Wimbush, 1893–1894. Invalided with beri beri after eleven months. Returned and worked at Kota and on *Charles Janson.*

Mr. H. M. Pearson, 1893–1894. Four months on *Charles Janson*; two months, Chisumulu; six months, Likoma. "A good deal of fever." *Died from hyperpyrexia.*

Mr. A. H. Butler, 1893–1894. *Blackwater fever after fourteen months, second attack after twenty months. Died.*

Mr. M. C. Kerr, 1893–1895. Much fever. Invalided.

Mr. R. B. Smith, 1893. Constitutionally unfitted. Invalided in under a year.
Miss M. G. Palmer, 1893–1895. *Blackwater fever* after two years. Invalided.
Dr. F. A. Robinson, 1893–1894. A good deal of fever. Invalided for beri beri. After eleven months resigned.
Mr. P. E. Brooke, 1895. Neurotic. Constitutionally unfitted. Invalided after about three months with symptoms of paresis.
Rev. J. G. Philipps, 1894. Six months at Likoma. Frequent fevers. Paretic symptoms which cleared up. Went to Kota in 1895.
Mr. A. Dutton, 1895–1897. On *Charles Janson* and at Likoma. *Blackwater fever* after two and a quarter years. Two months later, a relapse, from which *he died.*
Nurse A. Rees, 1895–1897. *Blackwater fever* (?) after eight months. Fair health for rest of time. Withdrew after eighteen months.
Rev. P. E. Faulkner, 1895–1896. (Had been three years in Zanzibar.) *Blackwater fever* after seven months, and again a month later, Invalided. (*Returned May*, 1897, *and died at Kota from blackwater fever August*, 1897.)
Rev. A. G. B. Glossop, 1895–1896 and 1897–1900. Had been on *Charles Janson* for one and a half years. Fair health at Likoma, but a good deal of fever Erysipelas, May, 1896, went for furlough. After return, very fair health.
Miss F. E. Ellershaw, 1895–1897. Fair health for one year. Then frequent fevers. *Died from blackwater fever after twenty months.*
Rev. R. S. Coupland, 1896–1899. Had been three years in Zanzibar diocese. Little fever, but suffered from boils and ulcers.
Mr. H. Williams, 1896–1898. Frequent fever with delirium. (Died at Unangu after two and a half months from coma. Cause ?)
Rev. W. A. Margesson, 1896–1897. Frequent fever. (After seventeen months went to Kota, and, after five months there, invalided. Died at Blantyre, on way home, from *blackwater fever.*)
Nurse M. Gardiner, 1896. Invalided after four months. Constitutionally unfitted.
Rev. E. B. L. Smith, 1896, 1897, 1898. Had been eight years at Masasi, then two and a half years at Chisumulu. Good health at Likoma. Left for furlough, June, 1897. Returned, June, 1898. Good health for rest of year.
Nurse E. P. D. Sanigear, 1897. Slight fevers. Then one month's continued pyrexia ; cause ? Invalided (after ten months' residence). *Blackwater fever* in England four months later.
Miss L. M. Windsor Aubrey, 1897. Good health. Went home with Nurse Sanigear after ten months, as the station was closed for ladies.
Rev. H. J. Hancock, June–December, 1897. Good health. Went to Mponda's later.

LIST OF WORKERS, 1899–1903.

(*a*) Old members who had been working prior to 1899 and were acclimatized —
Rev. A. G. B. Glossop, 1899 and 1901–1903. Good health. Little fever. Gets anaemic and run down at the end of about three years.
Rev. E. B. L. Smith, 1899–1902. Indifferent health. Developed malarial cachexia with impairment of memory.
Right Rev. Bishop Hine, 1899–1901. Poor health. Frequent attacks of malaria which he neglects.

(*b*) New members who were in no way acclimatized :—

Rev. C. Davies. Excellent health.
Mr. R. W. Kelsall, January–June, 1899. Rather frequent mild attacks of fever.
Miss Kenyon, 1899–1900. Excellent health for eighteen months. Then an attack of prolonged pyrexia (six weeks). Cause ? Had an attack of iritis.
Miss Schofield, 1899–1900. Frequent fevers for five months in 1900, otherwise very good health. Had an attack of iritis.
Dr. R. Howard, 1899–1900 and 1902–1903. Five attacks of malaria in first year. Then no more at all.
Mr. E. M. De Jersey, April–July, 1899. Had malaria with three relapses. Became discouraged and withdrew. He was not invalided.

Rev. H. Barnes, 1900–1901. Frequent slight attacks of malaria ; but fair health.
Mr. F. George, 1900–1903. Good health, Occasional sharp attacks of malaria.
Mr. H. S. Miller, 1900–1902. Very fair health, but inclined to be hypochondriacal.
Miss M. Newton, 1901. A good deal of fever first three months, then good health.
Nurse E. F. Lyons, January–June, 1901. Good health.
Nurse Armstrong, 1901–1903. Very good health.
Miss N. L. Mann, November, 1901–May, 1902. Very good health. No fever.
Rev. W. B. Suter, 1902–1903. Very good health. Only two or three attacks of fever.
Miss Nixon Smith, 1902–1903. Good health at first. Rather frequent attacks of fever at end of second year.
Mr. H. E. Ladbury, January–May, 1902. Good health.
Right Rev. Bishop Trower, 1902–1903. Good health. Little fever.
Miss H. Medd, 1902–1903. Good health.
Mr. A. Crabbe, 1903. Excellent health, no malaria.
Nurse Williams, June–December, 1903. Very good health. No fever.

SUMMARY, 1899–1903.

Total number of workers, 23 . . Of these three were old members and more or less acclimatized, but the rest were quite new to the country.

Invalided, None . . . . . One withdrew. He was hypochondriacal, and so constitutionally unfitted, but he might have stayed out his two years, and he was not invalided.

Deaths, None.

Haemoglobinuria or blackwater fever. None.

Malindi Health Record Statistics.

LIST OF WORKERS, 1898–1903.

Mr. F. W. Bradshaw, 1898–April, 1900. Acclimatized. Five years at Likoma on *Charles Janson* and Unangu. Fair health, but very liable to neuralgia from bad teeth.

(Mr. W. Sanday, 1899. Fair health but several sharp attacks of fever.)

Mr. J. E. T. Heppel, 1899–November, 1900. A frequent visitor to Fort Johnston. Several attacks of malaria. Blackwater fever in September. Invalided in November, 1900.

Rev. R. S. Coupland, January–December, 1899. Acclimatized. Had been three years in Zanzibar diocese, and two and a half years at Likoma. Fair health, but suffered from ulcers.

Mr. D. Lewis, June, 1899–December, 1900. Excellent health. No malaria.

Miss L. M. Windsor-Aubrey, October, 1899–March, 1900 and June–November, 1900. Rather poor health. Some malaria. Became neurotic and depressed. Left for furlough and then withdrew. Had a slight attack of modified small-pox in July, 1900.

Mr. H. Davies, January-July, 1900. Frequent attacks of malaria with high temperature. Excitable. Neurotic. Went to Mponda's in July. Invalided as constitutionally unsuitable, October, 1900.

(Mr. Christie, 1900–April, 1902. Good health).

Mr. J. E. Crouch, February, 1900–February, 1902. Acclimatized. Eight years at Likoma and on *Charles Janson*. Little malaria. Fair health. Had a good deal of worry. During 1900 troubled with colic, possibly from an inguinal hernia, since, after he got a truss, which kept the hernia up, he was much better.

Nurse E. F. Lyons, January–November, 1900, June–October, 1901. Good health. Only one attack of malaria.

Miss J. E. Jameson, June–November, 1900. Good health. One attack of malaria acquired on the river.
Rev. H. J. Hancock, June–October, 1900. Only one attack of malaria. *Died from appendicitis.*
Mr. R. Swinnerton, June–September, 1900, November–December, 1901. Good health.
Miss N. L. Mann. June–November, 1901. Good health. One attack of malaria.
Nurse K. Minter, November, 1901 March, 1902. Good health. No malaria.
Mr. P. Young, November, 1901–March, 1902. No malaria.
Rev. C. Davies, May, 1902–1904. Excellent health. One attack of malaria, probably acquired at a lakeside village, when returning from Conference at Likoma.
Miss M. Schofield, August, 1902–1903. Very good health. No malaria.
Nurse A. Murton, August, 1902–October, 1903. Rather frequent attacks of malaria with relapses, infection almost certainly acquired at Mponda's.
Dr. R. Howard, August–November, 1903. Very good health. No malaria.

Kota Kota Health Record Statistics.

LIST OF WORKERS, 1894–1898.

Rev. A. F. Sim, September, 1894–October, 1895. Frequent attacks of malaria. *Died from exhaustion after blackwater fever* after fourteen months at Kota Kota.
Mr. J. G. Philipps, May, 1895–November, 1896. Frequent attacks of fever.
Rev. J. S. Wimbush, November, 1895–June, 1897. Fair health.
Rev. W. W. Auster, July, 1896–February, 1899. Rather frequent fever. Two severe attacks in December, 1896, and January, 1899, for which he was taken to Likoma. Went home after the second severe attack, i.e., before his intended three years were up.
Mr. H. Matthews, May, 1897–July, 1899. Rather poor health. Frequent attacks of fever.
Rev. W. A. Margesson, November, 1897–March, 1898. Frequent attacks of fever with high temperature. Invalided. *Died at Blantyre from blackwater fever* with suppression of urine and uraemia.

LIST OF WORKERS, 1899–1903.

Rev. H. J. Hancock, February–September, 1899. Good health. No fever.
Rev. F. W. Stokes, April, 1899–May, 1902. Fair health during first two years except for one attack of continued pyrexia. Poor health during third year, frequent attacks of malaria. Modified small-pox (a very slight attack) in April, 1902. He had been successfully revaccinated in 1900.
Mr. J. P. Clarke, April, 1899–April, 1901. Good health. Four or five slight attacks of malaria.
Miss M. A. Cameron, April, 1899–March, 1901. Had been three years in Zanzibar. Fair health, but inclined to be hysterical. In December, 1900, had a sharp attack of malaria followed by several relapses. She became discouraged and depressed so was sent home for furlough.
Nurse K. Minter, April, 1899–November, 1900 and May, 1901–1903. Good health. Only occasional attacks of malaria.
Miss L. M. Windsor-Aubrey, September, 1899 and March–June, 1900. Good health.
Mr. R. J. Dell, July–November, 1900. Good health. One attack of malaria.
Miss J. E. Jameson, November, 1900–May, 1902. Good health. Very little malaria. Inclined to be neurotic.
Nurse C. Glover, December, 1900–September, 1901. Poor health, Seven attacks of malaria in ten months.

Mr. F. George, April–December, 1901. Good health, Two sharp attacks of malaria.

Rev. F. W. Folliott, October–November, 1901. *Died from hyperpyrexia* complicating an attack of malaria.

Nurse E. F. Lyons, October, 1901–January, 1902. Fair health, but nervous and unstrung by Folliott's death. Went to Fort Jameson and Bandawe in February, and, in March, left for home on furlough, stayed two weeks in Fort Johnston nursing a case of blackwater fever and a week at Zomba. Had severe malaria at Chiromo. Died at sea near Madeira from apoplexy (? cerebral thrombosis or embolism), complicating an ordinary mild attack of malaria.

Miss M. Newton, January–November, 1902. Good health. An attack of cellulitis of leg lasting two weeks.

Rev. A. J. Douglas, April, 1902–January, 1904. Fair health but several attacks (five) of malaria in second year.

Miss N. L. Mann, May, 1902–May, 1903. Good health. No malaria, but got run down.

Dr. R. Howard, June, 1902–January, 1903. Good health. No malaria.

Nurse P. E. Williams, January–June, 1903. Good health.

Miss W. Bulley, July, 1903–January, 1904. Poor health October–December. Malaria with several relapses.

Nurse J. H. Matthew, July–October, 1903. Fair health, No malaria. Suffered with menorrhagia.

SUMMARY.

Total number of workers, 19. All (except Miss Cameron) new to the country.
Total Deaths, 1.
Invalided, None.
Blackwater fever, None.

Mponda's Statistics, 1896-1903.

LIST OF WORKERS.

Rev. J. G. Philipps, November, 1896–November, 1897, December, 1898–August, 1902. First time frequent slight attacks of fever. Second time better health, but slight fever rather frequently. Spleen enlarged on return home for furlough.

Mr. R. M. Vyall, November, 1897–May, 1899. An attack of malaria about every two months. Run down and anaemic. *Died at Blantyre* from malignant malaria and *blackwater fever*.

Rev. H. J. Hancock, 1898. Good health except for one long attack of fever.

Mr. R. W. Kelsall, July, 1899–July, 1900. Frequent attacks of fever. Poor health. *Blackwater fever* in June. Invalided.

Mr. H. Faulkner, June–October, 1900. Good health. Withdrew.

Mr. J. E. T. Heppel, December, 1898–November, 1900. Stationed at Malindi, but often at Mponda's and Fort Johnston on visits. *Blackwater fever* in September, 1900. Invalided in November.

Mr. R. J. Dell, November, 1900–June, 1902. Fair health. Occasional fever only.

Rev. A. G. de la Pryme, April, 1899–June, 1900, and September, 1902–1903. First time, frequent fever, second time fair health with slight attacks of fever.

Mr. J. E. Crouch, November, 1900–June, 1901. Fair health. Only occasional fever.

(Mr. Christie, November, 1900–June, 1901. Fair health. Only occasional fever.)

(Mr. Maclure, November, 1900–June, 1901. Fair health. Only occasional fever.)

Mr. H. E. Ladbury, May, 1902–December, 1903. Poor health, Fortnightly attack of fever.

Rev. O. Fitzgerald, July–September, 1902. Malaria with several relapses. Withdrew.

Unangu Statistics.

LIST OF WORKERS, 1893–1900.

Dr. J. E. Hine, September, 1893–January, 1896. Slight attacks of fever about once a week. Invalided for cellulitis of foot and lymphangitis of leg.

Mr. W. Cowey, September, 1893–February, 1894. Much fever. Invalided after ten months in country. Developed *blackwater fever* at Chinde and died at sea, March, 1894.

Mr. J. Williams, 1894. Had been nineteen years in Africa. Acclimatized. Fair health.

Mr. F. W. Bradshaw, 1895. Frequent attacks of fever, about once a week.

Mr. H. Williams, May–July, 1898. Had been one and three-quarters years at Likoma, where he had frequent fevers; in poor health on arrival at Unangu. Suffered there from rheumatic pains. Cause? *Died comatose after four days' illness, with headache. Blackwater fever?*

Mr. J. P. Clarke, May–November, 1900. Three slight attacks of fever; then fair health.

Mr. F. George, May–November, 1900. A good deal of fever first three months, then fair health.

Steamer Health Record Statistics.

LIST OF WORKERS ON "CHARLES JANSON," 1886–1901.

(*a*) Laymen living mainly on the steamer.

Mr. W. Bellingham, 1886-1888. Had been five years in Zanzibar diocese. Acclimatized. Fair health.

Mr. G. Sherriff, 1886–1891. Fair health. *Died Comatose. Cause: Sunstroke?*

Mr. G. Tulip, 1894–1895. An elderly man. Fair health. *Died Comatose. Cerebral hæmorrhage?*

Mr. R. Belcher, 1888–1889. Fair health. Only remained one year, then withdrew.

Mr. T. C. Matthews, 1893–1894. Much fever, January–April, 1894. Invalided with paralysis, beri beri (?), July, 1894. Recovery incomplete. Tenotomy performed in England, but he remained crippled.

Mr. D. Lewis, January–July, 1899. Fair health, but frequent slight attacks of malaria.

Mr. R. Swinnerton, September, 1900–May, 1902. Good health. Occasional attacks of fever.

(*b*) Laymen living half time on the steamer and half time at Likoma.

Mr. W. Williams, 1888–1892 and March, 1896–April, 1899. Fair health during first period. Then came out to test Johnston (working for Messrs. Yarrow) in August, 1899. Invalided after severe *blackwater fever* in 1893. Returned November, 1896, early in 1897, had *blackwater fever*, severe attack with relapses. Then had fair health till 1899, when he got run down and anaemic and had several attacks of fever. Invalided.

Mr. J. W. Mills, 1887–1890. Good health.

Mr. J. E. Crouch, 1891–1898. A good deal of fever, but fair health.

Mr. T. Corbett, 1892–1895. Good health.

Mr. F. W. Bradshaw, 1893–1987. Frequent fever, but fair health between whiles.

(*c*) Clergy who spent nearly half their time ashore in the lakeside villages.

Rev. W. P. Johnson, 1882–1899. Had been six years in Zanzibar diocese. Frequent attacks of fever. Suffered much from indigestion and at times from ulcers and

anaemia, and in 1896–1897 from severe headaches. In 1899 got overdone in attempting to itinerate in the lakeside villages, without the steamer, so went to the College in 1900.

Rev. A. G. B. Glossop, October, 1893–February, 1895. Fair health. Fever about once a month.

Rev. J. S. Wimbush, June, 1897–October, 1898. Had been two years at Kota. Fair health.

Rev. C. B. Eyre, 1896–1901. Acclimatized by travel. Much fever first two years. Then fair health, but got run down in 1901 before he left for furlough.

Rev. H. Barnes, May–December, 1899. Itinerated with Rev. W. P. Johnson. Several severe attacks of fever.

LIST OF WORKERS ON "CHAUNCY MAPLES," 1902 and 1903.

Mr. P. Young, 1902–1903. Fair health. Occasional attacks of fever. A little run down in 1903.

Mr. J. H. Partridge, May, 1902–1903. Excellent health.

Archdeacon Johnson, May, 1902–1903. An attack of dysentery in 1902. Indigestion and constipation as of old, but fair health on the whole.

Rev. R. H. Marsh, May, 1902–1903. Bad health. Frequent attacks of malaria with high temperature brought on by persistent carelessness when living ashore in the villages.

Mr. R. Swinnerton, March–April, 1902, and November–December, 1903. Fair health. Inclined to be hypochondriacal.

Rev. C. B. Eyre, 1903. Not very good health. A good many slight attacks of fever, and inclined to get run down and exhausted.

HEALTH RECORD STATISTICS, 1894–1898.

During this period there were never more than two members of the Mission resident, so that statistics do not count for much; moreover, it was a pioneer period with the usual accompanying risks.

The Rev. A. F. Sim died from exhaustion following on blackwater fever in 1895. His death was probably due to the special strain of pioneer work, coupled with the absence of medical or nursing attention.

The Rev. P. E. Faulkner died on August 23, 1898, from exhaustion, with septic parotitis following on blackwater fever. He had suffered from two previous attacks of blackwater fever at Likoma, and had only been five days at Kota before his attack developed, so that it cannot be attributed to the place.

Messrs. Philipps, Auster, Wimbush, and Matthews all had rather poor health with frequent attacks of fever; but during this period the health record as a whole was probably not worse than that of Likoma.

The Rev. W. A. Margesson was resident from November, 1897, to March, 1898; he had much fever, and was invalided home, but developed blackwater fever at Blantyre, and died on April 5, 1898. Possibly his death should be referred to the Kota record, although he had previously been seventeen months at Likoma, where he had frequent fevers.

Nyasa (Likoma Diocese). A General Statistical Record.

FROM 1882–1903.

1. List of missionaries (period of service, etc.)
2. Tabular list of deaths.
3. Tabular list of persons invalided.
4. Tabular list of cases of haemoglobinuria or blackwater fever.

1. LIST OF MISSIONARIES IN LIKOMA DIOCESE.

N.B.—Where no remark is added the member has withdrawn from work for some reason or other, but has not died or been invalided. The figures in brackets under the heading "Time of Service" denote years spent in the Zanzibar diocese.

Name.	Dates.	Time of Service in Years.	Stations at which he Worked.	Remarks.
Rev. W. P. Johnson . . .	1882-1903	21 (& 6)	*C.J.* College. *C.M.*	B.W.F., 1900. Still working.
Rev. C. A. Janson . . .	1882	— (& 1½)	——	Died on arrival at lake.
Rev. G. H. Swinny . . .	1885–1887	1½ (& 1)	Likoma, *C.J.*	Died.
Mrs. Swinny	1885–1888	3 (& 1)	Likoma	Invalided. Died on voyage home.
Mary Swinny	1885–1886	—	Child aet. 4. Died at Likoma under 1 year	——
Rev. C. Maples	1886–1895	10 (& 9)	Likoma	Drowned.
Mr. J. Williams	1887–1895	8 (& 11)	Likoma. Chisumulu. Unangu. .	Drowned.
Rev. L. H. Frere . . .	1885–1892	7	Likoma	Invalided.
Mr. W. Bellingham . . .	1884–1888	4 (& 5)	*C.J.* (& Matope, building *C.J.*) . .	
Capt. G. B. B. Callaghan .	1884–1885	1	*C.J.* (Matope, building *C.J.*) . .	
Mr. W. Robinson . . .	1884–1885	1	*C.J.* (Matope, building *C.J.*) . .	
Mr. R. Creighton . . .	1884–1884	1	(Matope, building *C.J.*)	
Mr. A. Read	1884–1885	1	(Matope, building *C.J.*)	

Name.	Dates.	Time of Service in Years.	Stations at which he Worked.	Remarks.
Mr. C. Alley	1885–1892	7	(Matope). Likoma	Invalided. (Died in England of tubercular meningitis.)
Mr. G. Sherriff	1886–1891	5	*C.J.*	Died.
Mr. W. Williams	1888–1892 & 1896–1899	6	Likoma and *C.J.*	B.W.F. Invalided 2 years later.
Mr. J. W. Mills	1887–1890	3½	Likoma and *C.J.*	——
Mr. R. Crawshay . . .	1887	¼	——	(Only joined for a few months).
Mr. F. W. Wilde	1891–1892	1 (& 3)	Likoma	Died.
Mr. L. O. Warner . . .	1888–1889	½	Likoma	Invalided. Constitutionally unfitted.
Mr. R. Belcher	1888	¾	*C.J.*	——
Miss M. E. Woodward . .	1888–1896	8 (& 3)	Likoma	——
Miss S. C. McLaughlin . .	1888–1892	3	Likoma	——
Dr. J. E. Hine	1889 & 1893–1901	9 (& 2)	Likoma. Unangu. Bishop of Likoma	Invalided, 1889. Translated to Zanzibar, 1901.
Miss S. Fountaine . . .	1891–1892	1½ (& 10)	Likoma	——
Miss F. E. Turner . . .	1890–1892	2	Likoma	——
Mr. J. E. Crouch	1890–1898	8	Likoma and *C.J.* (Malindi, Mponda's)	(Paid member, 1901–1902.)
Mr. R. W. Lewis	1891–1892	1	Likoma	B.W.F. Invalided. Died on voyage.
Mr. B. W. Pullinger . . .	1892–1893	¾	Likoma	Invalided. Return allowed, but withdrew.
Rev. G. W. Atlay . . .	1892–1895	3½	Likoma. Chisumulu. Likoma . .	Invalided after B.W.F. Returned. Killed.
Mr. T. Corbett	1892–1895	3	Likoma and *C.J.*	——
Bishop Hornby	1893–1894	1	Likoma, etc.	Constitutionally unfitted. Invalided.
Mr. F. W. Bradshaw . .	1893–1900	7	Likoma. *C.J.* Unangu. Mponda's . Malindi	——
Rev. J. S. Wimbush . .	1893–1898	5	Likoma. Kota. *C J.*	Invalided for beri beri. Returned.

Name.	Dates.	Time of Service in Years.	Stations at which he Worked.	Remarks.
Mr. H. M. Pearson	1893–1894	1	*C.J.* Chisumulu. Likoma.	Died.
Mr. A. H. Butler	1893–1895	$1\frac{3}{4}$	Likoma	B.W.F., two attacks. Died.
Mr. W. Cowey	1893–1894	$\frac{3}{4}$	Likoma. Unangu	Invalided. Died. B.W.F on voyage.
Rev. E. B. L. Smith	1893–1903	10 (& 8)	Chisumulu. Likoma. (Nkwazi)	Still working.
Rev. A. G. B. Glossop	1893–1903	10	*C.J.* Likoma. College. Likoma	Still working.
Dr. F. A. Robinson	1893–1894	1	Likoma	Invalided. Beri beri. Withdrew.
Miss M. G. Palmer	1893–1895	2	Likoma	B.W.F. Invalided.
Mr. M. C. Kerr	1893–1895	$1\frac{3}{4}$	Likoma	Invalided.
Mr. R. B. Smith	1893	1	Likoma	Constitutionally unfitted. Invalided.
Mr. T. C. Matthews	1893–1894	1	*C.J.*	Invalided. Beri beri. Crippled.
Mr. G. Tulip	1894–1895	1	*C.J.*	Died.
Rev. A. F. Sim	1894–1895	$1\frac{1}{4}$	Kota Kota	B.W.F. Died.
Rev. J. G. Philipps	1895–1903	8	Likoma, Kota Mponda's	Still working.
Mr. P. E. Brooke	1895	$\frac{1}{2}$	Likoma	Constitutionally unfitted. Invalided.
Mr. A. Dutton	1895–1897	$2\frac{1}{4}$	Likoma and *C.J.*	B.W.F., with relapse. Died.
Rev. P. E. Faulkner	1895–1897	1 (& 3)	Likoma	B.W.F. Two attacks. Invalided. Returned. Died from third attack B.W.F.
Nurse A. Rees	1895–1897	$1\frac{1}{2}$	Likoma	B.W.F. ? ? ? after 8 months.
Miss F. E. Ellershaw	1895–1897	$1\frac{3}{4}$	Likoma	B.W.F. Died.
Rev. W. W. Auster	1896–1898	$2\frac{1}{2}$	Kota Kota	Invalided. Return allowed, but withdrew.
Rev. R. S. Coupland	1896–1899	3 (& 4)	Likoma. Malindi.	——
Mr. H. Williams	1896–1898	2	Likoma. Unangu	Died comatose. ? ? B.W.F.
Rev. W. A. Margesson	1896–1898	$1\frac{3}{4}$	Likoma. Kota	Invalided. Died at Blantyre, B.W.F.
Rev. C. B. Eyre	1896–1903	7	*C.J.* and *C.M.*	Still working.
Nurse M. Gardiner	1896	$\frac{1}{4}$	Likoma.	Constitutionally unfitted. Invalided.
Mr. H. Matthews	1897–1899	$2\frac{1}{2}$	Kota.	——
Rev. H. J. Hancock	1897–1900	$2\frac{1}{2}$	Likoma. Mponda's. Kota. Malindi	Died from appendicitis.
Mr. R. M. Vyall	1897–1899	2	Likoma. Mponda's	B.W.F. Died.
Miss L. M. W. Aubrey	1897–1900	$2\frac{1}{2}$	Likoma. Kota. Malindi	———
Nurse E. P. D. Sanigear	1897–1898	$\frac{3}{4}$	Likoma	Invalided. B.W.F. at home.

Name.	Dates.	Time of Service in Years.	Stations at which he Worked.	Remarks.
Mr. R. W. Kelsall	1898–1900	1¾	Likoma, Mponda's	Invalided. B.W.F.
Mr. J. E. T. Heppell	1898–1900	2	Malindi	Invalided. B.W.F.
Mr. D. Lewis	1898–1902	2½	*C.J.* Malindi. *C.J.*	——
Rev. C. Davies	1898–1903	5	Likoma. College. Malindi.	Still working.
Miss M. A. Cameron	1899–1901	2 (& 3½)	Kota Kota	——
Nurse K. Minter	1899–1903	5	Kota. Malindi. *C.M.* Kota	Still working.
Rev. F. W. Stokes	1899–1902	3	Kota Kota	——
Rev. H. Barnes	1899–1903	5	*C.J.* Likoma. College	B.W.F., 1903. Still working.
Rev. A. G. de la Pryme	1899–1903	5	Mponda's, Malindi. College. Mponda's	Still working.
Mr. E. M. de Jersey	1899	¼	Likoma	Constitutionally unfitted. Withdrew.
Mr. J. P. Clarke	1899–1901	2	Kota. Unangu.	At home. Reading for orders.
Dr. R. Howard	1899–1903	5	Likoma. Kota. Malindi.	Still working.
Miss E. Kenyon	1899–1901	2	Likoma	——
Miss M. Schofield	1899–1903	5	Likoma. Malindi	Still working.
Mr. F. George	1900–1903	4	Likoma. Unangu. Kota	Still working.
Mr. H. Davies	1900	¾	Malindi. Mponda's	Invalided. Constitutionally unfitted.
Nurse E. F. Lyons	1900–1902	2½	Malindi. Likoma. Malindi. Kota	Died during voyage home.
Miss J. E. Jameson	1900–1902	2	Malindi. Kota	——
Mr. H. J. Faulkner	1900	¼ (& 6)	Mponda's	——
Mr. H. S. Miller	1900–1903	3 (& 2½)	Likoma	——
Mr. R. J. Dell	1900–1902	2	Kota. Mponda's	——
Mr. R. Swinnerton	1900–1903	3	Malindi. *C.J.* *C.M.*	Still working.
Nurse C. H. Glover	1900–1901	¾	Kota Kota	——
Miss M. Newton	1900–1903	3	Likoma. Kota Kota	Still working.
Nurse M. Armstrong	1901–1903	2½	Likoma	Still working.
Miss N. L. Mann	1901–1903	1½	Malindi. Likoma. Kota	Still working.
Rev. F. W. Folliott	1901	⅙	Kota Kota	Died.
Rev. A. J. Douglas	1901–1903	2	*C.J.* and Likoma. Kota	Still working.
Rev. R. H. Marsh	1901–1903	2	*C.J.* *C.M.*	Still working.

Name.	Dates.	Time of Service in Years.	Stations at which he Worked.	Remarks.
Rev. W. B. Suter	1901–1903	2	Likoma	Still working.
Mr. P. Young	1901–1903	2	Malindi. *C.M.*	——
Mr. H. E. Ladbury	1901–1903	2	Likoma. Mponda's.	Still working.
Miss K. H. Nixon Smith	1901–1903	2	Malindi. Likoma	Still working.
Bishop Trower	1902–1903	1¾	All stations in diocese	Still working.
Rev. O. Fitzgerald	1902	½	Likoma. Mponda's	Withdrew.
Mr. H. Partridge	1902–1903	1¾	*C.M.*	Still working.
Mr. A. Brimecombe	1902–1903	1¾	*C.J.* and Likoma. College	Still working.
Nurse A. Murton	1902–1903	1¼ (& ¾)	Malindi	Still working.
Miss H. Medd	1902–1903	1¼	Likoma	Still working.
Nurse P. E. Williams	1902–1903	1	Kota. Likoma.	Still working.
A. H. Crabb	1902–1903	1	Likoma	Still working.
Miss W. Bulley	1903	½	Kota Kota	Still working.
Nurse J. H. Matthew	1903	½	Kota Kota. Malindi	Still working.
Bro. A. K. W. Spurr	1903	¼	College	Still working.
Bro. A. G. H. Sargent	1903	¼	Mponda's	Still working.
Mr. L. H. Willcocks	1903	¼	Likoma	Still working.
Rev. Wm. C. Piercy	1903	—	Kota Kota	Still working.

Total number of workers, 109.
Number who were acclimatized by work in Zanzabar diocese previously, 11.
Number still at work, 1904, 35.

2. TABULAR LIST OF DEATHS.

1882-1903.

Date.	Name.	Time of Service in years.	Cause of Death.	Station to which Death is referable.
Feb. 21, 1882	Rev. C. A. Janson	— ($1\frac{1}{2}$)	Fever. Diarrhoea. Exhaustion	——
Feb. 13, 1887	Rev. G. H. Swinny	$1\frac{1}{2}$ (& 1)	Fever. Exhaustion	——
May 31, 1888	Edith M. Swinny	3 & 1	Fever. Exhaustion ?	Likoma.
Aug. 12, 1891	George Sherriff	5	Coma. Cause ? Sunstroke ?	*C.J.*
July 20, 1892	F. W. Wilde	1 (& 3)	A malignant form of fever	Likoma.
Mar. 15, 1892	R. W. Lewis	1	Fever and exhaustion. Had suffered from B.W.F.	Likoma.
Mar. 6, 1894	W. Cowey	1	B.W.F.	Unangu.
May 26, 1894	H. M. Pearson	1	Fever. Exhaustion. Hyperpyrexia.	Likoma.
Jan. 15, 1895	A. H. Butler	$1\frac{3}{4}$	B.W.F., second attack	Likoma.
Mar. 13, 1895	G. Tulip	1	Coma. ? Cerebral haemorrhage	*C.J.*
Aug. 26, 1895	Rev. G. W. Atlay	$3\frac{1}{2}$	Killed by Magwangwara	——
Sept. 2, 1895	Bishop C. Maples	10 (& 9)	Drowned	——
Sept. 2, 1895	J. A. Williams	8 (& 11)	Drowned	——
Oct. 18, 1895	Rev. A. F. Sim	$1\frac{1}{4}$	B.W.F. (exhaustion after)	Kota Kota
July 9, 1897	Miss F. E. Ellershaw	$1\frac{3}{4}$	B.W.F.	Likoma.
Aug. 23, 1897	Rev. P. E. Faulkner	1 (& 3)	B.W.F., third attack (exhaustion after, with parotitis)	Likoma.
Sept. 11, 1897	A. Dutton	$2\frac{1}{4}$	B.W.F. with suppression	Likoma.
April 5, 1898	Rev. W. A. Margesson	$1\frac{3}{4}$	B.W.F. with suppression	? Likoma. ? Kota.
July 30, 1898	Howell Williams	2	Coma. Cause ? (B.W.F. ?)	Unangu.
May 29, 1899	M. Vyall	2	Malignant malaria with B.W.F. and parotitis	Mponda's.
Oct. 16, 1900	Rev. H. J. Hancock	$2\frac{1}{2}$	Appendicitis	——
Nov. 10, 1901	Rev. F. W. Folliott	1	Malaria. Hyperpyrexia	——
May 2, 1902	Nurse E. F. Lyons	$2\frac{1}{2}$	Coma. ? Cerebral embolism	——

Total deaths, 23. Of these 3 *were accidental.*

3. A TABULAR LIST OF PERSONS INVALIDED.

1882–1903.

Year.	Name.	Time of Service in years.	Cause of Invaliding.	Station to which referable.	Remarks as to return.
1889	L. O. Warner	½	Constitutionally unfitted	——	Refused.
1889	Dr. J. E. Hine	½	Frequent fevers with hyperpyrexia	Likoma	Allowed.
1892	Rev. L. H. Frere	7	Extreme anaemia	Likoma	Refused.
1892	C. Alley	7	Anaemia. Very large spleen	Likoma	Allowed (but died at home from tubercular meningitis)
1893	B. W. Pullinger	¾	Frequent fevers	Likoma	Allowed, but withdrew.
1893	Rev. G. W. Atlay	2	B.W.F. (several attacks ?)	Chisumulu	Allowed.
1893	R. B. Smith	1	Constitutionally unfitted	——	Refused.
1894	Bp. W. B. Hornby	1	Unsuited for African life	——	Resigned.
1894	Rev. J. S. Wimbush	1	Beri beri ?	Likoma	Allowed.
1894	Dr. F. A. Robinson	1	Beri beri ?	Likoma	Withdrew.
1894	T. C. Matthews	1	Beri beri ?	*C.J.*	Refused. Crippled.
1895	M. C. Kerr	1¾	Frequent fevers	Likoma	Refused.
1895	Miss M. G. Palmer	2	B.W.F.	Likoma	Refused.
1895	P. E. Brooke	½	Constitutionally unfitted	——	Refused.
1895	Rev. P. E. Faulkner	¾ (& 3)	B.W.F., two attacks	Likoma	Allowed. (Died B.W.F. in 1897
1897	Nurse Gardiner	⅓	Constitutionally unfitted	——	Refused.
1898	Nurse Sanigear	¾	Continued pyrexia. One month Cause ?	Likoma	B.W.F. in England. Refused.
1899	Rev. W. W. Auster	2½	Severe attacks of fever	Kota	Allowed, but withdrew.
1899	W. Williams	6	Anaemic. Depressed. Two attacks B.W.F. previously.	*C.J.*	Refused.
1899	E. M. de Jersey	⅓	Hypochondrical	——	Resigned.
1900	R. W. Kelsall	1¾	B.W.F.	Mponda's	Allowed, but withdrew.
1900	H. Davies	¾	Frequent fevers. Hysterical	Malindi	Refused.
1900	J. E. T. Heppell	2	B.W.F.	? Malindi ? Mponda's	Withdrew.
1900	Archdeacon Johnson	18 (& 6)	B.W.F.	College	Allowed.
1902	Rev. O. Fitzgerald	½	Discouraged. No valid reason	——	Resigned.

TABULAR LIST OF PERSONS INVALIDED.

Summary.

Total number invalided		22
Resigned on their own initiative		3
Of these invalided—Return allowed and returned		5
	Return allowed, but withdrew	4
	Withdrew without reference to Medical Board	2
	Return refused	11

Of those whose return was refused—

5 *were constitutionally unfitted* and only remained a short time in Africa, and were not anxious to return.

6 *were genuinely invalided* though they wished to return.

4. A TABULAR LIST OF CASES OF BLACKWATER FEVER OR MALARIAL HAEMOGLOBINURIA.

Date.	Name.	Service in Years.	Result.	Station to which Referable.	Remarks and Duration of B.W.F. Where Known.
Feb. 1892 .	R. W. Lewis	1	Invalided	Likoma .	Died at Durban from "Fever and exhaustion."
Sept. 1893 .	Rev. G. W. Atlay . .	2	Invalided. (Returned) . . .	Chisumulu .	? Several attacks.
Mar. 1894 .	W. Cowey . . .	1	Died (at sea, on way home) . .	Unangu . .	Invalided from Unangu, but developed B.W.F. at Chinde.
June, 1894 .	A. H. Butler . . .	1¼	Recovered. Remained at work .	Likoma . .	——
Jan. 1895 .	A. H. Butler . . .	1¾	Died	Likoma . .	Hyperpyrexia.
Oct. 1895 .	Miss M. G. Palmer . .	2	Invalided	Likoma . .	"*B.W. lasted* 3 *days.*"
Oct. 1895 .	Rev. A. F. Sim . . .	1¼	Died (from exhaustion) . . .	Kota . . .	Urine had cleared before death.
April, 1896 .	Rev. P. E. Faulkner .	½ (& 3)	Recovered	Likoma . .	——
May, 1896 .	Rev. P. E. Faulkner .	⅔ (& 3)	Invalided home. (Returned) .	Likoma . .	Return allowed March, 1897. Arrived May, 1897.
Aug. 1897 .	Rev. P. E. Faulkner .	1(& 3)	Died (from exhaustion and *parotitis*)	——	Urine cleared 14 days before death.
Early in 1897	W. Williams . . .	3½	Recovered and remained at work for two years	——	There were several relapses of B.W.F. Invalided home.
July, 1897 .	Miss F. E. Ellershaw .	1¾	Died	Likoma . .	Retention of urine.
July, 1897 .	A. Dutton	2	Slight attack. Recovered . .	? Likoma ? *C.J.*	——
Sept. 1897 .	A. Dutton	2¼	Died	? Likoma ? *C.J.*	Suppression of urine.
Mar. 1898 .	Rev. W. A. Margesson .	1¾	Died	? Likoma ? Kota	Suppression and uraemia.
July, 1898	Nurse Sanigear . . .	1	Recovered. Return refused . .	Likoma . .	Invalided home Feb. Attack occurred in England about six weeks after her arrival.
May, 1899 .	R. M. Vyall	2	Died. B.W.F. preceded by an attack of malignant malaria with collapse. There was parotitis	Mponda's .	Haematemesis before B.W.F. Suppression of urine. *Attack determined by quinine.*
May, 1900 .	R. W. Kelsall . . .	1½	Invalided. (Withdrew) . . .	Mponda's .	Return approved by M. B.
Sept. 1900 .	J. E. T. Heppell . . .	1¾	Invalided. (Withdrew) . . .	? Malindi ? Mponda's	Haematemesis.
Oct. 1900 .	Archdeacon Johnson .	18 (& 6)	Invalided. Returned	College . .	*Attack determined by quinine.* B.W. 48 hours, 2 relapses of 17 and 10 hours.
Jan. 1903 .	Rev. H. Barnes . . .	4	Recovered. Remained at work, *Slight parotitis* (not suppurative)	College . .	*Attack determined by quinine. B.W. lasted* 42 hours.

(Doubtful cases.—Nurse Rees, June, 1896 ? Howell Williams, died comatose, July, 1898 ? Urine like blood ?)

Total number of patients, 17. *Total number of deaths*, 8. *Total number of attacks*, 21.

A TABLE SHEWING THE ANNUAL RETURN OF DEATHS, INVALIDING AND BLACKWATER FEVER AND THE APPROXIMATE NUMBER OF WORKERS DURING EACH YEAR FROM 1887–1903.

Year.	Number of Workers (including those on Furlough).	Deaths.	Invaliding.	Attacks of B. W. F.
1887	12	1	—	—
1888	14	1	—	—
1889	11	—	2	—
1890	12	—	—	—
1891	14	1	—	—
1892	16	2	2	1
1893	22	—	3	1
1894	22	2	3	2
1895	23	6 (3 accidental)	4	3
1896	19	—	—	2
1897	23	3	1	5
1898	23	2	1	2
1899	26	1	2	1
1900	31	1	4	3
1901	32	1	—	—
1902	35	1	—	—
1903	37	—	—	1

MONTHLY RETURN OF DEATHS AND BLACKWATER FEVER.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Deaths	1	2	3	1	4	0	3	2	1	2	1	0
B.W.F.	2	1	2	1	3	1	2	1	3	3	0	0

QUARTERLY RETURN.

Deaths—1*st quarter*, 6. 2*nd quarter*, 5. 3*rd quarter*, 6. 4*th quarter*, 3.
B.W.F.— ,, 5. ,, 5. ,, 6. ,, 3.

THE END.

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